Charles University in Prague

Faculty of Social Science (IES)

BACHELOR THESIS

Florian Fiebig

Evaluation of Effects of "Cash for Clunkers" –like programs on car markets and macroeconomic situation

Supervisor of the bachelor thesis: Ing. Vilém Semerák, M.A., Ph.D.

Study program: Bachelor of Economics and Finance

Study branch: Economics and Finance

Prague, 27th July 2016

Declaration of Authorship

I declare that I carried out this bachelor thesis independently, and only with the cited sources, literature and other professional sources. I understand that my work relates to the rights and obligations under the Act No. 121/2000 Sb., the Copyright Act, as amended, in particular the fact that the Charles University in Prague has the right to conclude a license agreement on the use of this work as a school work pursuant to Section 60 subsection 1 of the Copyright Act.

Therefore, I grant to Charles University permission to reproduce and to distribute copies of this thesis document in whole or in part.

Prague, 27th July 2016

Signature

Acknowledgements

Before I start with my bachelor thesis, I would like to take a moment to express my sincere appreciation to my supervisor, Ing. Vilém Semerák, M.A., Ph.D., for his continuous support throughout this study, as well as in regards to related research, for his patience, motivation, and immense knowledge. Without his guidance, I would have not been able to accomplish this study.

In addition, I would like to thank my friend Robin Bhattacharya and Jane Chacko, who took care of the spelling as well as provided continuous inspiration for a broader view on the topic.

Abstract

Since 2008, countries all over the globe are dealing with the effects of the economic crisis of 2007/08 – a fall in GDP, trade and employment. Despite the fact that most countries were affected in a similar way, some countries seem to react quickier than to others with regards to taking actions for recovery. One policy approach that gained popularity was the car scrappage program, which allowed owners of eligible cars to receive a subsidy of €2 500. Besides stimulating the national automobile industry, the program also functioned as a partial remedy in the fight against global warming since it also focuseed on reducing vehicle emissions. In order to evaluate how effective, the German car scrappage program of 2009 was with regards to generating substantial macroeconomic effect in the German economy as well as neighboring countries, we use Leontief's input-output model. In addition to allowing us to examine the economic activity of a country's national accounts, the model also has the advantage that simple input-output multipliers can be calculated which are relevant for evaluation purposes.

In fact, these multipliers helped us to discover that German car producers, Volkswagen and Opel, were the ones that benefited the most from the program as they together accounted for almost half of the number of cars that were purchased in 2009. In addition, the multipliers helped us to run a sensitivity analysis on the German economy, which showed that the transport equipment sector (automobile industry), while being the third most sensitive sector of the German economy during 2009, was the most lucrative spending option for the German government in order to promote financial stability and restore consumer confidence. Although this thesis provides some insight on the effectiveness of the German car scrappage program, our research suggests continued investigation on this program and its effects will yield further insights.

JEL Classification	C67, E62, E66, H30
Keywords	Economic Crisis of 2007/08, Input-Output Models, Fiscal Policy, Accelerated Vehicle Retirement Program (Car scrappage program), Input-Output multiplier
Author's e-mail	florian.fiebig@ymail.com
Supervisor's e-mail	vilem.semerak@gmail.com

Contents

Bachelor Thesis Proposal

Author:	Florian Fiebig
Supervisor:	Ing. Vilém Semerák, M.A., Ph.D.
Proposed topic:	Evaluation of Effects of "Cash for Clunkers" –like programs on car markets and macroeconomic situation

Topic characteristics

After the financial crisis in 2007-08, governments all over the world tried using several policies in order to promote growth and stability for their economies. On July 1, 2009, the USA launched its policy "Car Allowance Rebate System (CARS)", commonly known as "Cash for clunkers". It was a program designed to boost car sales, by giving the US residents an economic incentive to swap their old and economically inefficient cars for brand new models, which were more fuel efficient as well as produced less CO_2. In the same year, Germany tried to promote growth and stability using the same policy/program. However, this policy not only had an impact on the German economy, but on its neighbors' economies as well. It is interesting to determine if this policy's implementation was beneficial or rather harmed the economy even further.

Although several papers presented research on the effects of the cash-for-clunkers policy, I will focus on the effects that the German policy had on the Czech economy with specialization on its output and employment level in the automobile industry. In my thesis, I will try to analyse how strongly car sales were impacted by the policy, as well as determine if some of the hypotheses are valid.

Questions

1. How did the output level of Germany and the Czech Republic changed due to the introduction of the car scrappage program?
2. What effect did the car scrappage program have on the labour market? (If possible to evaluate)
3. Can we say that the program was a success or rather a failure in accomplishing its goals?

Outline

1. Introduction
2. Literature Review
3. Brief overview of car sales before and after the economic crisis (2005-2011) via Input Ouput data analysis
4. Methodology and Model
5. Data analysis and Empirical evidence
6. Outcomes and Effects
7. Conclusion
8. Bibliography

Core bibliography

1. **Busse, Meghan, Jorge Silva-Risso, and Florian Zettelmeyer**, "$1,000 Cash Back: The Pass-Through of Auto Manufacture Promotions," *The American Economic Review*, September 2006, *96* (4), 1253–1253.

2. **Hastings, Justine and Ebonya Washington**, "The First of the Month Effect: Consumer Behavior and Store Responses," *American Economic Journal: Economic Policy*, May 2010, *2* (2), 142–162.

3. **Kaul, Ashok, Gregor Pfeifer, and Stefan Witte**. "The Incidence of Cash for Clunkers:." *Working Paper Series* 68 (April 2012): n. pag. University of Zurich, Apr. 2012. Web. May 2015.<http://www.econ.uzh.ch/static/wp/econwp068.pdf>.

4. **Kavalec, Chris and Winardi Setiawan**, "An analysis of accelerated vehicle retirement programs using a discrete choice personal vehicle model," *Transport Policy*, 1997, *4* (2), 95–107.

5. **Knittel, Christopher R.**, "The Implied Cost of Carbon Dioxide Under the Cash for Clunkers Program," 2009. Working Paper, Sloan School of Management, Massachusetts Institute of Technology.

6. **Li, Shanjun, Joshua Linn, and Elisheba Spiller**, "Evaluating 'Cash-for-Clunkers': Program Effect on Auto Sales, Jobs, and the Environment," 2010. Working Paper, Charles H. Dyson Scool of Applied Economics and Management, Cornell University.

7. **Licandro, Omar and Antonio R. Sampayo**, "The Effects of Replacement Schemes on Car Sales: The Spanish Case," *Investigaciones Economicas*, May 2006, *30* (2), 239–282.

8. **Sallee, James M.**, "The Surprising Incidence of Tax Credits for the Toyota Prius," *American Economic Journal: Economic Policy*, May 2011, *3* (2), 189–219.

Author

Supervisor

Chapter 1

Introduction

As of 2008, countries all over the globe have to deal with the effects of another economic crisis. Although the economic crisis evolved quite slowly in the USA at the end of 2007 its impact started to become visible in Europe and other parts of the world by the fall of 2008. Today, several years after the crisis, economies worldwide are recovering. However, the effects will continue to be long lasting in the form of a country's public debt[1] and a pemanent loss of potential output[2] OECD (2014). The fact that the loss of potential output is permanently is claimed by the OECD (2014), who showed that even with a continuing recovery, most country's GDP may not catch-up to its pre-crisis trajectory. In addition to the financial losses, the crisis revealed some uncertainity with respect to the stability and reputation of the EU zone. While there were times when the EU zone displayed stability and developed a good reputation with actions like bail outs and recovery programs to secure jobs and social protection levels as well as promote economic investment, other times it seemed to lack both as countries were not able to finance their debt anymore, interest rates of government bonds were unsustainable and unemployment rose. Despite the ups and downs, the EU zone displays security since its members profit from the solidarity of other members as well as the interdependency of the zone.

While some countries struggled for a few years, others seemed to have found a successful cure for their economies quite quickly, as they recovered to old standards almost immediately. This raises the question; why do we observe such diversity in success in countries all around the globe? What enables some countries to be able to recover so quickly from such economic crisis? As many economists have already shown in their papers, a reason for this diversity is that the countries have different institutions (industry structures, sizes, etc.). Besides these differences, the socio-cultural, economic, political, and ethnical background can also play a crucial role in determining how well a country can adapt to a crisis. This makes it hard for some countries to

[1] Table 1.1, which can be found in the Appendix part of this thesis, displays the ratio of the Government debt to the country's GDP (OECD).

[2] Although the size of the losses is uncertain due to the fact that there is an inherent uncertainty with regards to estimating of a country's potential output, the OECD attempted to estimate the impact of the crisis. They derived the size of the impact from a comparison of the baseline potential output per capita to a counter-factual scenario OECD (2014). Figure 1.2 and 1.3, which can be found in the Appendix part of this thesis, show the results of the estimated effects of the crisis on the potential output. While Figure 1.2 shows the Percentage reduction in potential output per capita relative to a pre-crisis counter-factual scenario, Figure 1.3 displays the estimated effect on the potential output per capita of individual OECD countries (OECD, 2014).

find an efficient treatment that suits their specific needs, thereby allowng them to deal with the effects of the crisis. This difficulty, in fact, causes countries to follow a trial and error principle, where they keep on testing different approaches in the hope of finding the right treatment for their individual economies to recover from the crisis. Besides being less efficient with regards to time and cost, the trial and error method can cause countries to be stuck in the aftermath of the crisis for quite a long time.

Thus, we can see that it is not easy to find a general cure for this specific issue. One thing, however, was the main focus for all countries: to restore consumer's confidence in the financial markets and to have positive economic growth. From a macroeconomic point of view, economists believed that this can be achieved via a stabilisation policy, which can be done via monetary or fiscal policy. The main difference between the two policies[3] is the occassion when to use one over the other. While monetary policy seems more useful under a floating exchange rate, fiscal policy is used when there is a fixed exchange rate and high mobility of capital. While monetary policy is being used to look at inflationary issues, fiscal policy is used by countries to tackle economic growth issues via taxation and government spending. However, sometimes finding and using the right policy can be a struggle.

Belongia and Ireland (2015) investigated the use of monetary policy in the USA during the years 2000-2007. The use of monetary policy in this case is special, since Belongia and Ireland's paper ("The Evolution of US Monetary Policy: 2000 – 2007", 2015) pointed out that there was a gradual shift in the Fed's interest, away from using monetary policy to stabilize inflation and towards stabilizing output. In addition, a constant deviation of the federal funds rate allowed inflation to overshoot its original target (Belongia and Ireland 2015). This example shows how significant it is to choose the right policy approach, as in some cases a wrong or too loose monetary or fiscal policy can cause dramatic problems in other institutions.

Since the main focus of this thesis is with regards to Germany, we know that using monetary policy is not an option. The reasons (single currency and high mobility of capital) are connected to the fact that Germany is part of a monetary union. Being a member of a monetary union has a few benefits[4], however, one of the main drawbacks is the fact that it prevents Germany from taking individual actions on financial matters in treating the effects of the 2007/2008 financial crisis.

[3] In the Appendix, we included a table, Table 1.4, showing the pros and cons of both policies.
[4] The benefits of a membership in a monetary union are: the reduction in transactions cost of changing currency; the reduction of exchange risk leading to greater trade and foreign investment with the rest of the member countries (Europe in this case) and to lower a risk-premium embodied in the cost of raising capital; increased transparency in price comparison; and the political gains of closer union and cooperation brought about the greater closeness of economic relationships (Minford 2002).

Another issue of the economic crisis of 2007/08 was that the consumers started to be uncertain about the money and the stability of other financial institutions. Therefore, consumers started to save any extra income. This migh not seem dangerous at the first sight, however, if the consumers save the extra money in the form of cash, then it could lead to a liquidity trap, which is very dangerous for the perfomance of an economy. Thus, in order to remove this uncertainty and to deal with the effects of the crisis, countries started to use fiscal policy. Although there is a vast literature on such fiscal policies and their effects for the specific country, this thesis is focusing on the effects of the car scrappage program (Abwrackprämie) used by Germany. Specifically, this thesis tries to provide some insight on the effects of the program on the German production and labor market, as well as on its neighbor, the Czech Republic.

In an attempt to isolate the effects of the car scrappage program, this thesis will be making use of the Leontief's input-output model. The main advantage of the Leontief's input-output model is that it enables the reader to study the industrial structure of the domestic and foreign market by displaying a country's economy as a whole. Therefore, the model allows to evaluate a country's industries in regards to productivity and profitability. Although, this model was developed by Wasily Leontief in 1938 and is often critizied for some its simplicity, it is, in fact, that simplicity which makes it prefered over similar models by many economists.

When it comes to evaluating the efficiency of fiscal policy, it might be better to look at all countries in the world. This is particularly the case since some countries might be too small with regards to size or insitutions as to have a visible impact from policies like the car scrappage program. However, this thesis is lacking the space and time for this. Therefore, we are focusing specifically on five countries: Germany, the Czech Republic, the USA, China, and Russia, as well as two areas, the EU25 and the Rest of the World. The term EU25 refers to the sum of all member countries except the Czech Republic and Germany, since it would otherwise lead to double counting. A similar procedure was applied on the economic area Rest of the World, which includes Australia, Bulgaria, Brazil, Canada, India, Indonesia, Japan, Korea, Mexico, Romania, Turkey, Taiwan, and the original Rest of the World[5]. For this thesis, we collected data from the World Input-Output Database for these countries based on the years 2005-2011.

After this short introduction, this thesis follows up with Part 2, a review of literature that is related to fiscal policies and its tools as a mean to promote recovery from an economic crisis like the one from 2007/08. In Part 3, this thesis will provide more details regarding the German car scrappage program, as well as provide a possible tool, Leontief's input-output analysis, to

[5] Rest of the world is a scientific term which refers to all non-resident institutional units that enter into transactions with resident units, or have other economic links with resident units (OECD).

evaluate the effect of such a program. Part 4 is dedicated to displaying the methodology and model formation of the input-output analysis. Part 5 of this thesis focuses on displaying the results of the model and puts the results into economic context. Part 6 concludes the thesis by looking at whether the car scrappage program had a chance to generate substantial macroeconomic effects or whether the money should be spend in different sectors due to higher multiplier effects. In addition, Part 6 is dedicated to raising questions for future research on this topic, especially in areas where this thesis was either too short or lacked available information.

Chapter 2

Literature Review

Before we can start using Leontief's input-output model to evaluate the effectiveness of the car scrappage program on resolving the effects of the economic crisis in 2007/08, it is important to have some insight on the financial crisis as well as the response that was taken towards it. Since not all readers start with the same base of information, forming a common understanding of how the crisis affected the world economies and how some reacted towards it, is essential for the rest of this thesis.

Therefore, this part of the thesis is dedicated towards closing the gap by providing the reader with some general information in regards to the economic crisis, the need for fiscal policy, the fiscal policy response that was specifically taken by Germany, and the input-output model. While there is various literature on these specific topics, we selected a few papers that should provide crucial information on these topics and have evaluated them below.

2.1 The Economic Crisis of 2007/08

Today, many people are aware of the fact that the economic crisis, which started in the USA back in August 2007, had devastating effects on the global economy as countries experienced a fall in GDP, trade and employment. While many know about the effects of the economic crisis, many may not be aware of how it actually evolved and how quickly it started to affect countries worldwide. Therefore, we will begin by providing a quick overview of the evolution of the economic crisis.

Elliot (2011) points out that the financial crisis evolved over the course of five phases, before it became the worst crisis to hit the global economy since the Great Depression. Phase 1 started August 9th, 2007, as an influential multinational bank, BNP Paribas, announced its interest in investing into three hedge funds, which were specialised in the US mortgage debt (Elliot 2011). The problem with this investment was that the derivatives lead to financial losses, as they were priced much higher than they were worth. This might have been the first indication that something was going wrong in the financial sector. However, many people at this time lacked the knowledge that we now have in hindsight. The second phase, September 15th, 2008, was

marked by the collapse of the investment bank Lehman Brothers (Elliot 2011). This event was special in the sense that until that point, it was believed that all banks, no matter how risky they were, would be saved by the US government in times of crisis. However, the US government did not step in to bail out Lehman Brothers. On April 2nd, 2009, the global economy seemed to recover from the crisis as the London G20 agreed upon a $5 trillion fiscal expansion, an extra $1.1 trillion of resources to create jobs and boost economic growth, and to reform the banking system (Elliot 2011). Although some attempts were taken to improve the situation, it got worse and by May 9th, 2010, when the problem had switched from the private sector to the public sector (Elliot 2011). In addition, Elliot (2011) argues that neither the IMF nor the EU had the financial reserves to take care of this issue. However, we would argue that they did have the financial reserves available to them, but lacked the motivation to use them. Specifically, since at the beginning, a small amount would have sufficed to solve the issue, but the IMF and EU members were not able to agree upon a common solution. Therefore, we would argue that there was a coordination failure, which prevented the governments from acting together in a coordinated manner against the effects of the crisis.

The speed and dimension that the economic crisis affected economies worldwide called for drastic measures. Ait-Sahalia *et al.* (2012) points out that the main goal for the central bank and governments should have been to reform the banking systems and to restore consumer's confidence in the financial markets. As a response, economists suggested that the govenment should run an economic stabilization policy, which can be accomplished via two policies: monetary and fiscal. Having two policies to choose from, however, does not make the government's decision any easier, especially since each of these two policies has its advantages and disadvantages with regards to the timing and purpose. Andersen (2009) claimed that from a macroeconomic point of view, stabilization should be done via monetary policy, since it would allow the government and central bank to keep an eye on inflation. The problem, however, was that people had lost their trust in the financial sectors, which implied that monetary policy could not act as an efficient tool (Andersen 2009). Thus, in the hope of restoring consumer confidence and to promote stabilisation in the financial markets, countries put their trust in fiscal policy. However, the question we need to answer is whether fiscal policy was really the right policy? From macroeconomics, we know that the effectiveness of monetary or fiscal policy depends on a country's exchange rate regime[6]. While in an open economy with a fixed exchange rate[7] fiscal

[6] More information on the effects of fiscal and monetary policy in open economies under different exchange rate regimes can be found in the appendix, Table 2.1.

[7] Monetary policy is ineffective in a fixed exchange rate regime since the central bank is forced to sterilize the effects of traders from buying or selling domestic currency. Controlling the exchange rate has the effect that both

policy is effective and monetary policy is ineffective, it is vice versa under freely floating exchange rates[8]. Since the focus of this thesis is mostly on Germany and its neighboring countries, which have fixed exchange rate regime, we can see that fiscal policy is the go-to policy in regards to dealing with the effects of the economic crisis of 2007/08.

However, is it really that simple as to decide whether a policy is effective or not? In fact, one thing, which we did not consider yet, but acts as a crucial constraint with regards to effectiveness of fiscal policy is the healthiness of the German banking sector. The health of the banking sector is important since depending on the level of capitalization, the government knows how much reserves it needs to keep aside for a possible future stabilization of the banking sector. Namely, a healthy banking sector requires the government to keep less money aside for future stabilization reasons and rather provide funds for programs like "Cash-for-Clunkers". In addition, a healthy banking sector would incentivize foreign investment and spure domestic demand with regards to commodities and currency.

In order to get an idea of how well the German banking sector is doing, economists commonly use stress tests, which measure how crash resistant certain banks are under specific economic scenarios. Düllmann and Erdelmeier (2008) did such a stress test on the German banking system and discovered that the results are an economic downturn for the automobile sector. Inspite the fact that the share of credit exposure in the automobile sector is relatively small, their paper (Crash Testing German Banks, 2008) estimated the expected loss conditional on the stress event to increase by 70-80% for the total portfolio (Düllmann and Erdelmeier 2008). In fact, Düllmann and Erdelmeier (2008) confirmed that this change is the result of correlation effects to related industries. In addition to highlighting a few problems with the German banking sector, Düllmann and Erdelmeier (2008) estimated that the banks' economic capital increased between 8-20% at the expense of a slight decrease of the banks' own funds ratios from 12% to 11.4% on average. This indicates that during the time the crisis hit Europe, the German banking sector was quite healthy and overall well-capitalized.

Before we go on to review literature on fiscal policy, we need to point out that there might be structural effects associated with the car scrappage program which we have to worry about. (By structural effects, we mean that other potential reason why some people would be switching to smaller cars could be price signals, rising oil prices, etc.)

---

trade and foreign direct investement are reduced as well as it presents opportunity for corruption. Fiscal policy is effective under fixed exchange rate as it causes an increase in output.

[8] Fiscal policy is ineffictive in a floating exchange rate regime since fiscal expansion results in an exchange rate appreciation, which leads to a decrease in Net Exports. Monetary policy is effective under floating exchange rate as the economy experiences an increase in output.

2.2 Fiscal Policy

Although we established the need for stabilization and evaluation of fiscal policy as useful, these actions just seemed to be beginning when many economists expressed their concerns regarding fiscal policy. The main critisim was expressed with regards to the use, effectiveness, and sustainability of the fiscal policy to achieve long-term stabilization in the financial markets. In their study, Kuroiwa and Kuwamori (2010) focus on the effects of the financial crisis on U.S. imports, and discover that the impact on countries can differ depending on their involvement in the production network. Andersen (2009) even went a step further and claimed that it is hard to find one common policy that could solve the issue, since the countries simply differed too much with respect to globalisation, effectiveness of fiscal multipliers, and national interests. West (1995) supports Andersen's statement by showing in his study that even if the data and impact scenarios are identical, the results can differ quite substantially.

Although, it might be hard to find a common policy, Uhlig (2002) attempts to explain that acting uniteedly will yield a much better result than if each country would perform fiscal policies on their own. In fact, he claims that if several fiscal authorities are acting on their own with regards to fighting the impacts of the ant-inflationary measures by the central bank on their economy, then the coordination failure will cause the creation of deficits (Uhlig 2002). Therefore, finding a solution together will be more promising for all countries involved, then fighting the effects of a shock on their own.

Furthermore, Barrell *et al.* (2009) show that there exists an inverse relationship between the openness of a country and the size of the country-specific fiscal multipliers. This implies that countries which are relatively open to trade could have a disadvantage over others when it comes to the use of fiscal policy. This study, in fact, supports Blanchard and Leigh's (2013) claim that there is no unique fiscal multiplier and that relying on fiscal multipliers might not be suited for all countries alike. This can be seen by the fact that fiscal multipliers in some countries do not follow a symmetric trend, which implies that a change positively or negative can affect the economy more than the opposite. Therefore, an increase or decrease could be less effective as the opposite strategy. Thus in order to avoid this issue, we decided to use a simple model which has the advantage that it is difficult to reach asymmetry.

In addition to the vast literature which questions whether fiscal policy is appropriate to use in such a matter, there is some literature that focuses on the actual effectiveness of fiscal policy. However, before we can debate the effectiveness of fiscal policy, we need to point out that fiscal policy can occur in two forms: government spending (direct purchases and transfers) and tax

cuts. Afonso and Ricardo (2012) explored the effects of a government spending shock in the USA, UK, Italy, and Germany. They discovered that the impact of this government spending shock on the country's GDP is quite small and can result in a crowding out effect (Afonso and Ricardo 2012). Exploring the effect of a food subsidy, Hastings and Washington (2010) discovered that an increase in aggregate demand is linked with an increase in food prices. Adda and Cooper (2000), Licandro and Sampayo (2006), Mian and Sufi (2010), Li *et al.* (2010), Hahn (1995), Deysher and Pickrell (1997), Kavalec and Setiwan (1997), and Szwarcfiter *et al.* (2005), who examined the cost-effectiveness of different government spending programs on emissions reduction, discovered that one ton of emissions reduction can range between $2,000 to $85,000. Knittel (2009) goes a step further and claims that the Car Allowance Rebate System[9] is potentially a waste of money, after he observed that the costs of the Car Allowance Rebate System outweighed the social costs of carbon reduction by 4 to 10 times. Kweka and Morrissey (2000) discovered that goverment consumption spending shocks can be growth-enhancing, while physical or human capital investment will either affect growth negatively or take too long to make an immediate change.

Since fiscal policy in the form of government spending might not work all the time, Toder (2000) points to tax cuts, as he argues that tax cuts can be as efficient if not outperform government spending on a case-by-case basis. From macroeconomics, we know that tax cuts can be effective as they enable consumers to have more disposable income, which can be reflected in an increase of either consumption, saving or investment. However, is this form of fiscal policy a better alternative to government spending? Unfortunately, we cannot give a general answer to this question since the effectiveness of a tax cut depends on a case-by-case basis. Mäkelä and Österberg (2009) and Koski *et al.* (2006) reviewed the effects of the alcohol tax cuts[10] that took place in Finland in 2004. Mäkelä and Österberg (2009) discovered that besides an increase in alcohol consumption by 10%, the alcohol tax cuts were linked to increases in alcohol-related violence and alcohol-induced liver disease death, which increased by 46%. Koski *et al.* (2006) estimated an increase of 8 additional alcohol-positive deaths per week, which represented an increase of roughly 17% compared to 2003. This suggests that alcohol tax cuts might not be a good idea to implement by the government in order to achieve an increase in

[9] The term CARS, or also known as Accelerated vehicle retirement program or 'Cash-for-Clunkers', refers to a U.S. government program that allows individuals to trade in their used vehicle for more fuel-efficient alternatives and began on July 1st, 2009 (Gayer and Parker 2013).

[10] Please note that we are aware of the fact that alcohol is not an example of an effective tax cut. The reason for this is that cars are price sensitive, while alcohol lacks price elasticity. In addition, due to its nature, we know that the alcohol tax cut would affect mainly heavy drinkers, with respect to volume of demand, and have little to no effect on other industries. Nevertheless, we picked alcohol tax cuts to show that tax cuts could act as a reliable option for the government.

aggregate demand or to promote stability as it brings along quite a lot of problems. However, House and Shapiro (2004) offered an alternative for governments. In a comparison between the phase-in tax cuts of the 2001 tax laws and the immediate tax cuts of the 2003 tax laws, House and Shapiro (2004) discovered that the phase-in tax cuts result in a reduction in employment, output, and investment, while the immediate tax cuts provide significant incentives for an increase in production and investment. Diamond (2005) explored an extention of the 2001 and 2003 income tax cuts in combination with a reduction in government spending, and found that the combination will increase investment, employment, and output. Blanchard *et al.* (2009) questioned fiscal policy with respect to its sustainability and defined seven key characteristics for evaluation purposes. In fact, their reasoning and explanation for each characteristic is elaborated on, in their paper (Fiscal Policy for the Crisis, 2009):

i. Timely, due to the need for immediate action
ii. Large, due to the current and expected decrease in private demand
iii. Lasting, due to the time that the effects of the crisis persist
iv. Diversified, due to the degree of uncertainty associated with any single measure
v. Contingent, due to the fact that further actions might need to be taken in order to lower the probability of another "Great Depression"
vi. Collective, since countries were affected globally, their contribution should be equally
vii. Sustainable, in order to forstall a debt explosion and adverse reactions of financial markets.

In addition, there are two more things which Blanchard *et al.* (2009) did not mention, but will impact the sustainability of a fiscal policy, credibility and expectations.

i. Credibility, how much do government incentives and constraints affect the policy choice
ii. Expectations, the ability to measure the pros and cons of a fiscal policy prior to practice

Despite the fact that there is a vast literature that criticises fiscal policy, research proved that the success or failure of fiscal policy clearly depends on the industry, the dimension, and the timing in which the government practices it.

Caldara and Kamps (2008) remind us that the empirical literature that has been published on fiscal policy so far has failed to deliver the true qualitative effects of fiscal policy shocks on achieving specific goals. Liskova (2015) argues that we need an alternative method to evaluate economic impact analysis, as general equilibrium and vector autoregression models are underperfoming with regards to economic impact analysis, and suggests input-output analysis as a possible solution to the issue of measurement error. The works of Feldman et al. (1976), Tsoukalas (2011), Keogh and Quill (2009), Bensaid et al. (2011), and Lapeyre (2010) support the idea that input-output analysis can be used to successfully evaluate individual economies, based on their national accounts. Based on these facts, we will try to evaluate the German car scrappage scheme via the use of the Leontief input-output model and question whether the car scrappage program had a chance to generate substantial macroeconomic effects or whether the money should be spend in different sectors due to higher multiplier effects.

2.3 Input-Output Model

Back in 1936, Wasily Leontief published an article called ‚Quantitative Input and Output Relations in the Economic System of the United States' which proved to be valuable for future research on input-output analysis. In this article, he introduced the input-output model, which enables the user to study the industrial structure of the domestic and foreign markets, as well as to analyse trade influence and sector interdependence via displaying a country's economy as a whole. In addition, Liskova (2015) mentions in her paper ‚The Strengths and Limitations of Input-Output Analysis in Evaluating Fiscal Policy' (2015) that Leontief's model of input-output analysis is demand-driven, while other approaches are supply-driven[11]. This is a crucial aspect for the selection of a suitable model, since the economic crisis of 2007/08 was leading to a sharp decline of demand and firms' s competitiveness (Liskova, 2015). Baumol (2000), in fact, even goes as far as to declare this input-output analysis model as a major contribution to economics in the 20th century. In addition to its applicability, the input-output model is regarded as an attractive alternative, due to the fact that it can be made operational and accessible at a low cost (Park 2006).

[11] According to the OECD (2009), a supply-driven economic crisis can lead to innovation and industrial renewals, while a demand-driven crisis cannot lead to creative destruction. Instead, Schumpeter (1942) indicates that a demand-driven crisis can generate destructive forces, which can slow down economic growth, innovation, and industrial renewals.

While this model seems quite promising with regards to attatining a complete picture of an economy's structure, critics complain that the model is too simple to provide a basis that can be used for an analytical framework (Liskova 2015). Thus, must we question whether or not the input-output model can be used to evaluate the effectiveness of a strategy?

Lapeyre (2010) defines an effective strategy as one that is able to target the specifc sectors in an economy that generate the most value added, employment, have large multiplier effects and links to the domestic economy. Liskova (2015) views the input-output model as helpful in devising an appropriate macroeconomic and sectoral policy that and effectively supports the key sectors. In fact, Sasai *et al.*'s (2012) work has proven that an appropriate fiscal policy could be devised via input-output analysis, as the model helped to identify which energy sources have the highest energy consumption in each industry.

In addition, today, the input-output analysis is used globally in order to examine the economic activity of a country's national account. Guo and Planting (2000), for instance, used the input-output analysis to evaluate the influence of trade in the US economy, while Tretyakova and Birman (1976), Feldman *et al.* (1976), Tsouskalas (2011), and West (2011) conducted studies on the USSR, the USA, UK, and Australia, respectively, using the input-output approach. Reis and Rua (2009) use the input-output analysis to examine the interaction between Portugese linkages and leakages caused by international trade. Park and Chan (1989) investigate the relationship between service activities and the manufacturing sector using the input-output analysis and notice that the manufacturing sector acts more heavily than one might imagine as a form of input for the service activities. While Pietroforte and Gregori (2003) use input-output analysis in order to evaluate the role of the construction sector for output, value added, and GNP in Australia, Canada, Denmark, France, Germany, Japan, the Netherlands, and the USA, Kulatunga *et al.* (2006) use input-output analysis to analyse the importance of the construction sector in Sri Lanka. Zamecnik and Hlavac (2010) use the input-output analysis to estimate the impact of the fiscal stimulus and home insulation stimulus package in the construction industry. Suga (2012) tries to estimate how many people lost their jobs and how much Japanese exports decreased due to the financial crisis in 2008 by applying the input-output analysis.

Despite the fact that there is a lot of literature that proves how vastly input-output analysis is used, the work of Blanchard *et al.* (2009) and Liskova (2015) are the ones that are relevant for this thesis since their work demonstrates how the effect of fiscal policy and the form of fiscal policy can be determined via the multipliers calculated from input-output analysis. Blanchard *et al.* (2009) are able to assess that the multipliers are at their highest if the government spending increased or targeted tax cuts and transfers happened, while the multipliers are at their lowest

if the tax cuts are more generally oriented or subsidies are consumer- or firm-oriented. In fact, the difference in multiplier's size can be explained via a country's financial sectors, expectations and supply constraints. If a country has a weak banking sector then it needs to investment money on stabilization, while a country with a strong banking sector can use the money for programs-like "Cash-for-Clunkers". Therefore, a country with a strong banking sector does not need to use its reserves to bail out some of its financial sectors. Expectations is another thing that impacts the size of the multipliers, namely in the way that if you expect a country to do well in the future, then it will attain a lot of foreign investment. If, however, you expect a country to do badly, then mostly no one would invest money into that economy. Supply constraints can have the effect that the multipliers are overestimated as they cannot be clearly identified.

Although, Blanchard *et al.* (2009) demonstrate how useful multipliers can be with respect to examing fiscal policy, Epstein *et al.* (2009) remind us that a variation in the size of the multipliers can exist. In fact, Epstein *et al.* (2009) connect the variation in the multipliers to the difference in links between the industrial sectors and the economy. Thus, we need to be cautious when it comes to interpreting our results, especially the multipliers.

Chapter 3

Car Scrappage Program (Abwrackprämie)

The fiscal policy reaction towards the financial crisis of 2007/08

As of 2008, countries all over the globe had to deal with the effects of another economic crisis. Despite the fact that the countries concerned were on different level of industrialization or development, they seemed to be affected by the crisis in a similar way, namely a decrease in GDP, trade, and employment. However, it is important to notice that the channels differed with respect to pure trade linkages.

It was clear to governments worldwide that the speed and dimension in which the economic crisis affected their economies called for drastic measures. Ait-Sahalia *et al.* (2012) points out that the main goal for the central bank and governments was to reform the banking systems and to restore consumer confidence into the financial markets. However, the question was how can we accomplish these two goals? Andersen (2009) called for a fiscal policy as a policy response to the effects of the economic crisis and he eliminated the use of monetary policy due to the lack of confidence in the financial markets. Cook and Devereux (2011) went into more detail, calling for an expansionary fiscal policy, which implied an increase in government deficits, reduced taxes via tax cuts and simultaneously or alternatively an increase in government spending. In addition, Cook and Devereux (2011) stated that at the beginning, the G20 and some financial institutions tried to combine forces and find a suitable fiscal expansion policy. However, the problem was that these countries were too different in respect to globalisation, effectiveness of fiscal multipliers and national interests, to find a policy that would suit the needs of all of them (Andersen 2009). Thus, countries went with different forms of approaches to deal with this situation. While some countries acted as free riders and waited for other countries to find a successful fiscal policy, others attempted to find a solution on their own, often adhering to a trial and error principle more than a clearly defined plan. In fact, acting as a free rider is beneficial for smaller countries since they lack the financial funds to go through long trial and error processes and thus will benefit if the bigger countries take on the financial cost involved in the process of finding a suitable policy.

Despite the difficulty of finding a suitable fiscal policy response, some countries seemed to follow a similar trend. In fact, they created fiscal stimulus packages that were directed at different industries of their economies. Due to their popularity, „Cash-for-Clunkers“ and similar programs seemed to be adopted quite frequently (Kaul *et al.* 2012). In fact, this thesis will

examine the effects of the German Car Scrappage program on the domestic and Czech markets. Specifically, we will try to evaluate via input-output analysis and the computation of multipliers, whether the car scrappage program had a chance to generate substantial macroeconomic effects or whether the money should be spend in different sectors due to higher multiplier effects in terms of output and employment. But before we can compute and evaluate the tables and the multipliers, we need to provide more details on the car scrappage programs.

3.1 The German Fiscal Policy Response

Since there was the need for a strong fiscal stimulus, the German government decided to exercise government spending shock in the form of a demand subsidy. In fact, they devised a program that specifically focused on the car industry.

Some people might ask why did the German government designed a program that puts so much focus on the car industry, particularly when the whole economy was negatively affected by the economic crisis. The reason was given by Kaul *et al.* (2012), when they cited vice-chancellor Steinmeier, who identified the car industry as the backbone of the German economy. While the German automotive industry accounted for roughly 20 percent of total German industry revenue in 2014, it also ensured 775,000 people a workplace (Di Bitonto *et al.*, 2015). In their study, Kaul *et al.* (2012) pointed out that a program oriented at the automobile industry had three key advantages:

i. The program was environmental-friendly-oriented since it caused heavily polluting cars to be replaced by new and more efficient ones.
ii. The automobile industry would experience a boost, which would benefit Germany's and stakeholders and prevent layoffs, negative spillovers, and depreciation of consumer confidence.
iii. Consumers were economically incentivized to buy a new car, which was a multiplier effect for the economy.

Although, the program officially started on January 14th, 2009, the idea for a scrappage program was discussed previously on December 27th, 2008, by Vice-Chancellor Steinmeier (Kaul *et al.* 2012). The program was designed in a way that private individuals could receive a subsidy of € 2 500, if they fulfilled two conditions. The first condition was that the private individual needed

to scrap his/her old car. The crucial part, however, was that by the time of scrapping, the car had to be at least nine years old and been licensed to the individual at least 12 months prior to the scrapping (Kaul *et al.* 2012). The second condition regarded the purchase of a new car, which was required to be either an annual car or a newly-licensed car (Kaul *et al.* 2012). Thus, the program promotes the purchase of new cars and prevented free riders from exploiting the program via buying and scrapping old cars. Inspite of the program's popularity, it had two main issues: the economic side and the real-effect side.

By April 2009, the program had exhausted almost all of its original budget and seemed to end quite soon. Even though the government increased the budget from €5 billion to €7 billion, the issue just seemed to be prolonged, since the budget was officially exhausted by September 2nd, 2009 (Kaul *et al.* 2012). Despite the fact that the program was so short-lived, it encouraged the purchase of roughly 2 million new cars[12] (Kaul *et al.* 2012). Assuming a reasonable range for the average price of a car of €10-15 thousand, the total *direct* fiscal expenditure would be €20-30 billion. In any case, the investment of up to €7billion would seem to suggest that government incentives did lead to higher private expenditures.

The real-effect issue with the program was that lower price segment cars made up the majority of the new car purchases. Under initial examination, this fact does not seem bad, however, Kaul *et al.* (2012) point out certain issues in their paper (The Incidence of Cash for Clunkers, 2012): Dealers for lower price segment cars experienced a rising demand, while dealers of pricier cars had to deal with stagnation or decreasing demand. This consumption behavior caused dealers to practice price discrimination in order to promote the purchase of higher price segmented cars (Kaul *et al.* 2012). In fact, Kaul *et al.* (2012) observe that an additional discount of €1 100 was needed in order to ensure the purchase of a more expensive car. This implies that during this time period, there was some distortions in the car market.

Despite the flaws of the program, it seemed to have stimulated the German economy and neighbouring countries. Thus, we will try to evaluate it in respect to whether the car scrappage program had a chance to generate substantial macroeconomic effects or whether the money should be spent in different sectors due to higher multiplier effects, when it comes to output and employment. But before we go over the methodology and analyse the results, we will go over the International Transport Forum and focus on similar programs.

[12] Figure 3.1 and Table 3.2, which can be found in the appendix, display the structure of the roughly 2 million car sales over-time.

3.2 Other „Cash-for-Clunkers"-like Fiscal Policy Response

The idea of a car scrappage program is not new to most countries since governments have already implemented them in the past. In fact, the USA and Canada were the first countries to implement accelerated vehicle retirement (AVR) program as early as 1990 and 1996 with the same goals as Germany did in 2009 – reduce emissions and positively stimulate the national automobile industry (Fontana 1999). The difference between the two AVR programs, however, was with regards to benefits from scrapping. While the US program offered money for scrapping an eligible car, the Canadian program provided the owners of eligible vehicles two options: receive money in return for buying a new car or receive a one-year free transit pass for the local public transport network (Fontana 1999).

Despite the small difference, the success of the two programs did not remain unnoticed. In fact, Greece was the first European country to practice an AVR program in 1991, which lasted from January 1991 to March 1993 (Fontana 1999). By 1993, several other European countries (Hungary, Denmark, Norway, Spain, Ireland and Italy) have witnessed the potential of AVR programs and decided to initiate country-specific versions of the AVR program (Fontana 1999). While Hungary practiced a version similar to the Canadian program in terms of benefits, the other countries seemed to follow the US version – subsidy or tax relief (reduction of car registration taxes and road charges) (Fontana 1999).

In addition to mentioning countries that practiced AVR programs, Fontana's paper (Improving the Environmental Performance of Vehicles: Fleet Renewal and Scrappage Schemes 1999) provides insight on the evolution of AVR programs as he shows that the age requirements for eligibilty decreased quite a bit. While a car needed to be 15 to 20 years old to be eligible in the US AVR program of 1990, 10 years was enough for the programs that followed US footsteps. Another relationship that changed was that the subsidy that owners of eligible cars received increased over the years. While in the US in 1990 owners received US$500-600 per eligible car, owners in Denmark (1994), Ireland (1995) and Italy (1997) received US$1 000 per eligible car (Fontana 1999).

Today, the OECD acts as a platform for the International Transport Forum, an international organisation that specifically focuses on the transport industry. In 2011, the OECD published a paper (Car Fleet Renewal Schemes: Environmental and Safety Impacts, 2011) that provides more detail on the International Transportation Forum as well as mentions

the 52 member countries [13] (OECD, 2011). Taking a look at the members, we can see that they range from highly industrialized to less industrialized countries. Inspite of their difference, the objective of this organisation is to conduct tests on a range of transportation, to publish their results, to support policymaking decisions on a global scale, and to arrange an annual summit (OECD, 2011).

Liskova's paper (The Strengths and Limitations of Input-Output Analysis in Evaluating Fiscal Policy, 2015) highlights that Australia, Germany, Japan, the United Kingdom, and the USA followed „Cash-for-Clunkers"-like programs as a response to the financial crisis of 2007/08. Besides the fact that all of these countries are members of the International Transport Forum, we want to point out that these countries represent the automobile industry on four continents. This could imply that the International Transport Forum has evaluated the costs and benefits of such a program and validated the car scrappage scheme as a powerful response in respect to the financial crisis. In fact, the OECD (2011) adds three additional benefits to a car scrappage program, that the paper by Kaul *et al.* (2012) did not mention:

iv. A reduction of dependency on imported oil
v. An improvement of road safety
vi. An increase in employment and the creation of additional human capital

We discovered that there might be an additional benefit associated with concentrating on the automotive sector via the car scrappage program, which neither Kaul *et al.* (2012) or the OECD (2011) have thought of before:

vii. Concentrating on the automotive sector can facilitate organization of efficient lobbying activities

Despite the fact that the basic form yields positive results in tests, it leaves room for doubt as whether it is beneficial for all markets or just particular ones. But we are sure that the future will tell us.

[13] The 52 member countries are: Albania, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Canada, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, FYROM (Former Yugoslav Republic of Macedonia), Georgia, Germany, Greece, Hungary, Iceland, India, Ireland, Italy, Japan, Korea, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Mexico, Moldova, Montenegro, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, the United Kingdom and the United States (OECD, 2011).

During the last few years, the idea of „cash-for-clunkers" –like program has gained popularity not just among ITF member countries, but has also inspired some economists to focus their studies on the evaluation of such programs on the economies. Lavee and Becker (2008) conduct a cost-benefit analysis of an accelerated vehicle-retirement program on the Israel automobile industry. Their simulation shows that a AVR program would be beneficial for private cars, while trucks or buses would be rather unproductive since the costs would outweigh the benefits (Lavee and Becker, 2008). Szwarcfiter *et al.* (2005) investigated the potential of the Brazilian automobile industry to reduce emissions as a result of the implementation of Accelerated Vehicle Retirement and Vehicle Inspection and Maintenance Programs. Despite the fact that during the first few years the reduction in emissions would be insignificant, their study shows that as the program evolves and vehicle replacement increases, the reduction in emissions becomes quite significant (Szwarcfiter *et al.*, 2005).

Chapter 4

Methodology

This part of the thesis focuses on presenting the methodological background. Specifically, we are providing some information about the source and the compilation process of our data as well as briefly introducing the input-output tables and showing the calculation of the multipliers. Thus, the reader will have some information about the data and how we used it in this study.

4.1 Data Description

When we want to properly evaluate the effects of a fiscal policy on a specific economy, it might be better to look at all countries worldwide. However, this thesis is lacking both the space and the time to look at all countries. Therefore, we have restricted our study to five countries, Germany, Czech Republic, USA, China, and Russia, and two economic areas, EU25 and Rest of the World. Furthermore, we strictly collected data from the World Input-Output Database for the years 2005-2011.

Before we can explain our reasoning for choosing these countries, we will begin by briefly commenting on the two economic areas. In general, the term EU25 refers to the sum of all member countries: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovenia, Slovakia, Spain, Sweden, United Kingdom. However, for the purpose of this thesis, we use the term EU25 to refer to the sum of all member countries, except the Czech Republic and Germany. A similar procedure was applied on the economic area, Rest of the World, which includes Australia, Bulgaria, Brazil, Canada, India, Indonesia, Japan, Korea, Mexico, Romania, Turkey, Taiwan, and the original Rest of the World. Redefining these two economic areas has two reasons: the lack of space and the problem of double counting.

Even though this study lacks the space to analyse all countries individually, we know that we cannot simply exclude all oft hem due to a lack of space. One significant reason for this is the positive feedback caused by increased German expenditures resulting in higher earnings in, for example, EU25. Clearly, though, these earnings will result in higher EU25 expenditures

benefiting German producers. Therefore, in order to get a better view of the trade linkages between the coutries, it is better to use a multicountry input-output table. In order for us to all countries, we redefined the two economic areas, EU25 and RoW, in the hope to get a rough idea of how the two economic areas can be affect by or are affecting Germany. In addition, having a smaller number of countries to analyse helps us to keep track of the impacts of a fiscal policy as well as to make the input-output tables more reader-friendly. The second reason regards the prevention of the double counting problem, which would occur in case we included countries more than once in the input-output tables. For instance, if we were to add the Czech Republic and Germany to the EU25 term, then we would take the two countries twice into account. This would have the effect that we miscalculate the multipliers and fail to show the true effectiveness of the fiscal policy response. Therefore, in order to prevent double counting, we excluded the five countries, Germany, Czech Republic, USA, China, and Russia, from the two economic areas.

As for the selection of our countries, some people might question or rather critize our choice, since better choices could have been made from their point of view. For instance, Liskova (2015) investigated slightly different countries: Australia, Germany, Japan, United Kingdom, and USA. The reason that differentiates her selection from ours is that all of these five countries practiced both a „Cash-for-Clunkers" -like and a infrastructure investment program[14] (Liskova 2015). Our selection, however, lacks this aspect, since some countries have either practiced such fiscal policy programs without publishing it or have not practiced them at all. So why did we choose these five countries, if we cannot prove that all countries have practiced a „Cash-for-Clunkers" –like fiscal policy? What criteria did we use to base our decision on? Despite the fact that our selection of countries might not be optimal, we chose the countries according to three criteria: diversity, data availability, and trade relevance (size).

The first criteria, diversity, is important to us, since we want to take into account countries with different socio-cultural, economic, political, and ethnic backgrounds. In addition, we wanted the countries to be different with respect to their industrial structure and size.

As for the data availability, we are able to find all relevant information regarding the countries on the World Input-Output Database. In addition to the years that we selected to examine, there are more years to collect data from. In fact, the data base has data available from year 1995 to 2011.

[14] In case of interest, Liskova's paper (The Strengths and Limitations of Input-Output Analysis in Evaluating Fiscal Policy, 2015) provides more details on these countries. Specifically, she displays the sizes of the fiscal policy responses (see page 24).

Trade relevance is the third criteria that played a crucial role in helping us determine which countries to select. By trade relevance, we mean that we tried to choose countries that are important for Germany's trade linkages. Therefore, we omitted countries that are too small with respect to economic size or are too far away from Germany as to be drastically impacted by the car scrappage program. While we omitted them from the list of countries we chose to specifically investigate, we included them inside the two economic areas.

4.2 World Input-Output Database

When it comes to gathering information related to the national accounts of a country, there are many options to choose from. However, each database has its advantages and disadvantages compared to others. In addition, due to standardization, we were restricted to collecting our data from just one source. The reason is that gathering information from multiple sources can produce misleading results due to the fact that each database uses a different method to attain the data itself. Thus, we had to decide wisely which database we would use to collect data. In order to get a quick idea of the available databases, we included Table 4.1 which can be found below.

Table 4.1: Comparison of databases

	Number of Included Countries/Regions	Number of Sectors	Latest Available Data
TiVA (version 2015)	62	18 presented (34 in the original underlying IO data)	2011
WIOT/WIOD	40+1	35	2011
National IO tables published by Eurostat	31	65	2010
OECD	67	34	2011
GTAP version 9	140 regions	57	2011

Source: (OECD, Eurostat, and WIOD websites)

For this thesis, we use data that we collected from the World Input-Output Database for the years 2005-2011. Sure, there are other good options like the OECD or Eurostat databases, which economist use quite frequently for their studies. So, why did we not use either of them instead of the World Input-Output Database?

The main reason, why we chose specifically this database, is that it has the latest input-output tables available and we do not need to have a specific software to work with the data or spend hundreds of dollars in order to use it. In fact, the only software that a person would need to have is Microsoft Excel. This thesis relies heavily on Excel in order to calculate the multipliers from the input-output tables. Having Microsoft Excel, however, is not an issue, as it is a standard program in most computers today.

Another reason why we prefer this database over the other options, is that this database is very user-friendly. It provides pdf files on how to properly use the data and it compiles the input-output tables for us[15]. This is important to us, since it enables people to follow and to reproduce our work at ease.

The only downside of the World Input-Output Database compared to the other databases is that it has a lower number of industry sectors. Specifically, the World Input-Output Database takes 35 industries into account, while the other databases include 48 industries (Liskova 2015). Liskova (2015) argues that this allows users of the other databases to provide a more detailed and industry specific analysis. Inspite of the fact that the World Input-Output Database has less industry classifications compared to the other databases, we need to keep in mind that some databases either lack the ability to gather all the necessary information or produce industry classifications that are rather useless for our purpose. Thus, having a larger database would be rather inefficient and unproductive for this study since we would either have to gather the missing information or condense the database to the industry sectors that we want to investigate. Since the World Input-Output Database, however, includes all industry sectors of our interest, it was the best option for the purpose of this thesis.

Since we provided some insight on the data that we used, we are set for the next sections in which we will briefly go over the different Leontief input-output models, provide both the general as well as the thesis-specific structure of input-output tables and explain the calculation process for the multipliers.

[15] In case of interest, Liskova's paper (The Strengths and Limitations of Input-Output Analysis in Evaluating Fiscal Policy, 2015) provides more details on the compilation process of input-output tables, how some databases (eg. OECD and Eurostat) make use of this procedure, and how to access her input-output table database.

4.3 Input-Output Model

When it comes to using the Leontief model properly, the circumstances are very important since, depending on the type of economic crisis or policy that we want to analyse, the Leontief model can act as an efficient tool or not. As previously mentioned, we know that the Leontief model is demand-driven. Therefore, we know that the model would be properly used if we want to analyse an economic crisis or policy that is demand-driven. Whereas in the case of a supply-driven economic crisis or policy, Ghosh's (1958) model[16] would be better suited to analyse the effect, due to the fact that it is supply-driven.

Besides knowing when to use the Leontief model, recognizing that there are a few assumptions that go along with using the model is also important. In fact, there are six key assumptions the model imposes upon its use and that we need to be aware of:

i. Each industry has a fixed input structure for the production of its commodity. This is vital since 2011 was the latest data available to us.
ii. Each industry produces just one product, which is identical or produced in a fixed proportion. Furthermore, there cannot be a commodity that is produced via the combination of two or more industries.
iii. As for the production in every industry, we assume constant returns to scale. This implies that output of an industry will change proportionally to the change in inputs into that industry.
iv. As for the market structure, we assume a competitive market system with infinitely elastic supply of factor of production and capital at fixed prices.
v. We assume that there is no other policy that will stimulate the economy's national account.
vi. We assume that there are no other supply side constraints, or bottlenecks, that will affect consumption.

The first four assumptions are the general assumptions of the Leontief model, while we added the fifth and sixth one due to its significance for our thesis. Without fulfilling these assumptions, our model would not be able to produce any meaningful conclusions. However, once the assumptions are met, we are free to use the Leontief model and its benefits.

[16] Ghosh's supply-driven model becomes an alternative to Leontief's demand-driven model in case we have a monopolistic or centrally planned economy with scarce resources in all but one sector (Liskova, 2015).

Since this thesis focuses on the economic crisis of 2007/08, a demand-driven economic crisis, we know that the Leontief model is well-suited to take into account the economic impact of the crisis on the global economy. To be more precise, Liskova (2015) points out that using input-output analysis enables us to catch both intermediate and final flows between particular sectors, as well as the flow of intermediate commodities in a country's national account. The second benefit of the Leontief model compared to other models is that it has been used and improved over many years. This implies that there must be a lot of literature and expertise on which we can fall back and benefit from. In fact, previous and current research as well as continuing technological improvements enable us to use of input-output models at any geographic level – local, regional, national, and international.

Since we assume that the assumptions are met, we can start to define our model. As a matter of fact, using the right model is not an easy task, since there are two versions of the Leontief model[17] – open and closed. Furthermore, we need to recognize that both models are being used to analyse different things. While the open model is being used to analyse how much the production has to change in order to satisfy the change in demand for a certain commodity, we should use a closed model, when we want to estimate the impact on the income of an industry due to the change in demand (Tanaka, 2011). In addition, it gets even more complex, as we have to consider the dynamics (static or dynamic) of the model as well. Therefore, we have to understand what each term means in order to find the version that would best suit the purpose of this thesis.

i. Open – While some of the economy's production is being consumed internally by its industries, the rest is being consumed by outside industries via exports.
ii. Closed – The economy's entire production is being consumed by its own industries. Therefore, there is no overproduction which could be exported to other countries.
iii. Static – The input-output model assumes that the final demand vector is given.
iv. Dynamic – The input-output model implies that investment demand cannot be taken as given from outside, but must be explained within the model.

After looking at the different degrees of openess and dynamics and considering which degrees could be useful for us in regards to this thesis, we come to the conclusion that we should use a model that is a mix of different degrees. This is simply due to the fact that we are interested in estimating the production as well as income changes that are provoked by a change in the

[17] We would like to point out that the type of the model does not matter for the assumptions to be valid since both model types have to fulfill the same assumptions.

demand for a certain commodity. Moreover, we want to evaluate the multiplier effects, which we can only observe once we disregard the time constraint. Therefore, we will also have a mix in regards to the dynamics of the model.

4.4 Input-Output Table

Having the right model is important, however, having the data arranged/displayed in the right way is equally important. Therefore, we should take a moment and elaborate on the layout of the input-output tables before going over the calculation process of the multipliers.

Input-output tables are constructed in a simple, but well structured two-dimensional framework. The rows indicate the commodity that each industry produces, while the columns represent the inputs of each sector into the production process.

Figure 4.2: A rough layout of an input-output table

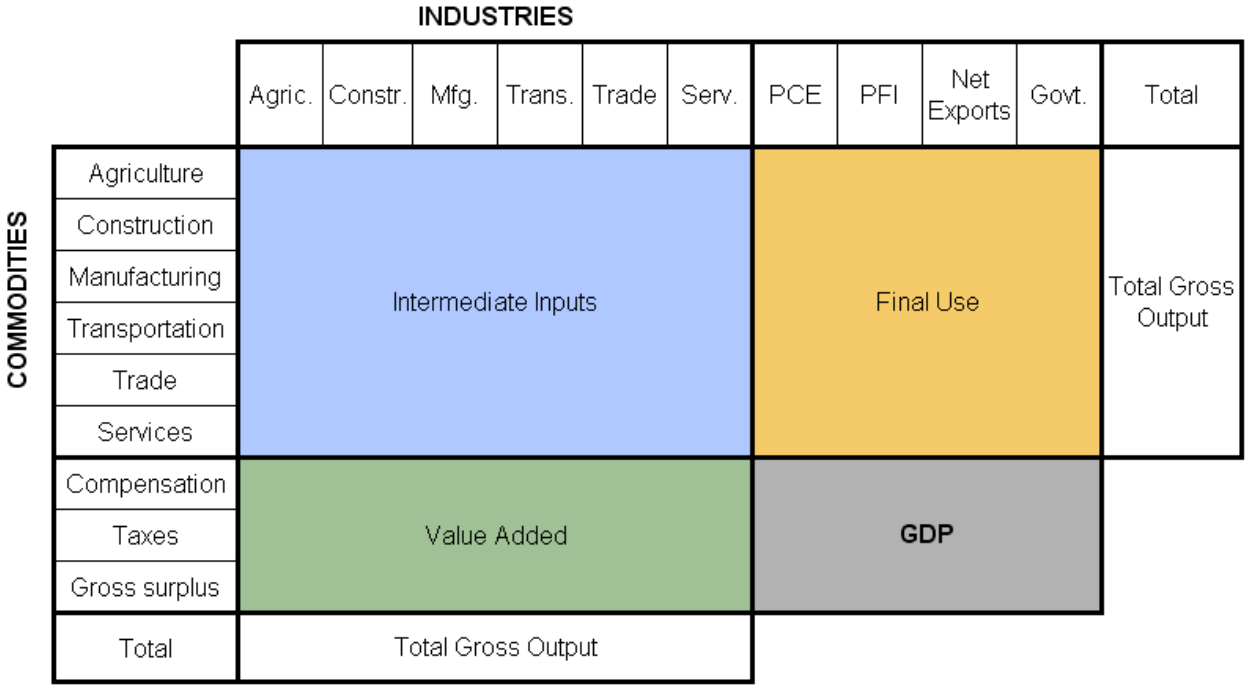
Purchases by:		Intermediate Users Sectors/Industries					Final Demands				Total Demand
		1	2	3	•••	n	C	I	G	E	X
Sales by:	1	X_{11}	X_{12}	X_{13}	•••	X_{1n}	C_1	I_1	G_1	E_1	X_1
	2	X_{21}	X_{22}	X_{23}	•••	X_{2n}	C_2	I_2	G_2	E_2	X_2
	3	X_{31}	X_{32}	X_{33}	•••	X_{3n}	C_3	I_3	G_3	E_3	X_3
Sectors/											
Industries	•	•	•	•	•••	•	•	•	•	•	?
	•	•	•	•	•••	•	•	•	•	•	?
	n	X_{n1}	X_{n2}	X_{n3}		X_{nn}	C_n	I_n	G_n	E_n	X_n
Value-	W	W_1	W_2	W_3	•••	W_n	W_C		W_G		W
Added	R	R_1	R_2	R_3	•••	R_n					R
Imports	M	M_1	M_2	M_3	•••	M_n	M_C	M_I	M_G		M
Total Supply	X	X_1	X_2	X_3	•••	X_n	C	I	G	E	

Source[18]*:* („Applications of Leontief's Input-Output Analysis in Our Economy" by Fujio Tanaka, 2011)

[18] Where X_i represents the total production of the ith sector, (i =1, 2, ..., n), X_{ij} shows the amount of goods and services that jth sector used from the ith sector in order to produce its output, (i, j =1, 2, ..., n), Wj represents the wages that are paid to workers in the jth sector, (j =1, 2, ..., n), R_j represents the interest and profits (rents) of the jth sector , (j =1, 2, ..., n), M_j shows the imports tot he jth sector, (j =1, 2, ..., n), C_j represents the personal consumption expenditures that occur due to the production in the ith sector, (i, j =1, 2, ..., n), I_j represents the

Despite their simple structure, these tables enable us to show flows of final and intermediate goods and services according to industry outputs (*industry-to-industry* tables) or according to product outputs (*product-to-product* tables) (OECD, 2015).

Figure 4.2: The five quadrants of an industry-to-industry input-output table



Source: („Input-Output Models for Impact Analysis: Suggestions for Practitioners Using RIMS II Multipliers" by Rebecca Bess and Zoë O. Ambargis, 2011)

After taking a look at Figure 4.2, we can observe that there are five quadrants that form the main framework of an input-output table: Intermediate Inputs, Final Use, Value Added, GDP, and Total Gross Output.

- The Intermediate Inputs quadrant measures the flows of goods and services between each industry. The columns represent all intermediate inputs that go into each industry's production process, while the rows display the amount of goods and services that are being used by other industries for their production.

investment expenditures that are associated with the production in the ith sector, (i, j =1, 2, ..., n), G_j represents the government purchases that are provoked by production in the ith sector, (i, j =1, 2, ..., n), E_j represents the exports that are associated with the production in the ith sector, (i, j =1, 2, ..., n), M_C, M_I, and M_G represent the amount of final goods and services that are imported by consumers, firms, and the government, while M_j shows the amount of goods and services that need to be imported for the production of goods and services in the ith sector, (i, j =1, 2, ..., n)

- The Final Use quadrant displays how the output is divided among the categories of final demand. Combing the Intermediate Inputs and the Final Use quadrant allows us to explain the total production from as well as the usage of each industry/commodity.
- The Value Added quadrant shows the primary inputs that are involved in each industry's production process: compensation of employees, gross operating surplus, value added at basic prices, and various taxes. In other words, this quadrant is equal to the income earned during the production process.
- The GDP quadrant displays how the primary inputs impact the final demand.
- The Total Gross Output quadrants display the total profit of the economy due to its production. In other words, the Total Gross Output quadrant is the sum of the intermediate inputs and the value added quadrant.

Nowadays, the industry-to-industry input-output table is being used by economists worldwide to determine the impact of a change in the demand of an industry's production on the rest of the economy. Therefore, using this type of input-output table seems to be quite promising when we want to analyse the impact of a policy or economic crisis on a specific country and its industries. However, the purpose of this thesis is not to analyse the economic impact of an economic crisis or policy onto a single country, but rather to analyse the industrial linkages between multiple countries at the same time. Constructing and combining multiple industry-to-industry input-output tables would not be effective since we would create a form of bias[19] and lose the casaulity impact. In order to prevent this, we will have to use a slightly different version of the industry-to-industry input-output table, known as intercountry input-output table. This slightly more complex version allows us to investigate the relationship between countries and their industries and not just the industries of one specific country.

Besides using a slightly more complex version of the industry-to-industry table, we have to make one more adjustment to the structure of the input-output tables so that we can use it. Specifically, we have to reduce the number of countries[20] involved in the tables from 40 to 7 countries. This is because we want to explicitly show the trade/economic impact between the

[19] We would create a form of omitted-variable bias since we ignore the link/impact that the countries would have with each other, if we would look at them individually. In addition, we know that with one table for all countries combined would help us to account for unobserved constant effects.

[20] According to their website, the World Input-Output database produces input-output tables that cover 27 EU countries and 13 other major countries in the world for the period from 1995 to 2011. Having this amount of countries involved is not necessary for this thesis as well as it rather makes it more difficult to find the information. As a matter of fact, we want to point out that the reduction of the intercountry input-output tables was quite tricky, since we had to calculate the data for the economic areas, which we did via the use of the summation function in excel.

Czech Republic, Germany, USA, China and Russia, as well as the two economic areas, EU25 and RoW[21]. Once these adjustments are done, we end up with a structure similar to the one that we can see in Figure 4.3.

Figure 4.3: The layout of a simple intercountry input-output table.

		Country A Intermediate use industry	Country B Intermediate use industry	Country C Intermediate use industry	Country A Final domestic use (C, I, G)	Country B Final domestic use (C, I, G)	Country C Final domestic use (C, I, G)	Total output
country A	industry	Intermediate use of domestic output by A	Intermediate use by B of imports from A	Intermediate use by C of imports from A	Final use of domestic output by A	Final use by B of imports from A	Final use by C of imports from A	Total output in A
country B	industry	Intermediate use by A of imports from B	Intermediate use of domestic output by B	Intermediate use by C of imports from B	Final use by A of imports from B	Final use of domestic output by B	Final use by C of imports from B	Total output in B
country C	industry	Intermediate use by A of imports from C	Intermediate use by B of imports from C	Intermediate use of domestic output by B	Final use by A of imports from C	Final use by B of imports from C	Final use of domestic output by C	Total output in C
		Gross value added	Gross value added	Gross value added				
		Total output in A	Total output in B	Total output in C				

Source: (WIOD conference presentation, 2010)

From the table above, we can see that the main framwork remains the same, but the diagonal and off-diagonal sections have a different meaning. The diagonal sections show the domestic transaction flows of intermediate goods and services across industries, while the off-diagonal parts show the intercountry flows of intermediates via exports and imports (OECD, 2015). This new layout has the advantage that we can rather analyze different questions or calculate additional indirect effects.

Before we can move onto the next part, where we will be explaining the calculation process of multipliers, we need to stress that we regarded both imports and exports as being included in the tables. This allows us to create a more realistic atmosphere compared to the scenario, when we regard the imports as being indirectly allocated[22]. In addition, having the imports and exports directly allocated is a much stronger assumption than indirectly allocated. However, this does not mean that indirect allocation of imports is not being practiced. In fact, McLennan (1995) is one of the economists who regards it a necessity to assume that the imports are indirectly allocated.

[21] In case the countries involved in these two economic areas are unlcear, please check Section 4.1 - Data Description on more detail.

[22] In her paper (The Strengths and Limitations of Input-Output Analysis in Evaluating Fiscal Policy, 2015), Liskova elaborates on the practical advantages of indirect allocation.

4.5 Types of Multipliers

Calculating multipliers is a good and effective way to display how much a production change in one specific industry influences the rest of the economy. As we want to investigate intercountry industrial linkages in this thesis, we can greatly benefit from calculating multipliers, since they will help us to extract valuable information regarding GDP, trade, and employment effects from the intercountry input-output tables.

When it comes to using multipliers, we need to be aware of the fact that they can display only first-round effects, or cummulative effects once all secondary effects have been accounted for (Liskova, 2015). In addition, Liskova (2015) points out that the multipliers will display average changes, but not marginal changes, due to the fact that we do not take into account production changes that occur because of economies of scale, unused capacity, or technological advances.

Besides its shortcomings, it is important to recognize that there are two types of multipliers that give the total impact measure its structure – Type I Multiplier and Type II Multiplier (Bess and Ambargis, 2011). Type I multipliers allow us to catch the cummulative effect of the direct[23] and indirect[24] impacts that were possibly provoked via a production change in one of the industries, while Type II multipliers enable us to catch the induced[25] impacts in addition to the direct and indirect impacts.

The difference in the total impact composition is simply due to the fact that we use different models in order to attain each type of multipliers. For the Type II multipliers, we need to have a Closed Leontief model, while an Open Leontief model is enough to get the Type I multipliers. Thus, we need to be careful, when it comes to choosing the right model. Especially, since we know that compared to the Closed Leontief model, where the economy's entire production is being consumed by its own final demand, the Open Leontief model assumes that some amount of the economy's production is being consumed by its own industries, while the rest is being consumed by outside industries via exports. Nevertheless, once the degree of openness of the model is clear, we know which combination of effects forms/makes up the total impact measure. In respect to our model, we already established that we use a mix of both

[23] *Direct effects* – As the final demand for a certain commodity changes (rises/fall), the production of that commodity needs to be adjusted (increase/reduced) in order to meet the change in final demand.
[24] *Indirect effects* – A change in the production of a commodity is provoked by the decision of the producer and not by a change in final demand. In other words, if the producer decides to change their production of a certain commodity, then the market/final demand for that commodity has to adjust to the change.
[25] *Induced effects* - A change in the final demand of a commodity that corresponds to the change in household income. In other words, this measure allows us to account for the purchases made by employees.

degree, which will allow us to use the benefit from both models – analyzing the production as well as income impacts provoked by a demand change. The problem with having a mix, however, is that we cannot be sure as to which effects combine to create the total impact measure. Therefore, we can get estimates that either over or understestimate the true total impact. Inspite of this uncertainty, Bess and Ambargis (2011) discover that both Type I and Type II multipliers can produce a similar total impact estimate as long as resources are easily/freely available in an economy.

Knowing the composition of the total impact is good, however, in order to evaluate the effects of the car scrappage policy on the economies of Czech Republic, Germany, USA, China, Russia, EU25, and RoW, it is not enough. We need to know how to calculate the total impact measure such that we can use it to evaluate the effects of the fiscal stimulus on the final-demand. In their paper (Input-Output Models for Impact Analysis: Suggestions for Practitioners Using RIMS II Multipliers, 2011), Bess and Ambargis (2011) show that there are two types of multipliers (final-demand multipliers[26] and direct-effects multipliers[27]), which we can calculate and that can solve the problem. In fact, Bess and Ambargis (2011) even explain the role/significance of each multiplier (definition) as well as provide a brief overview of their calculation procedures (application), which are displayed in Table 4.4 and Table 4.5.

Table 4.4: The two direct-effects multipliers

Multiplier	**Definition**	**Application**
Earnings	Total household earnings per $1 change in final-demand earnings	Final-demand earnings x direct-effect earnings multiplier = total earnings impact
Employment	Total number of jobs per 1 job change in final-demand jobs	Final-demand jobs x direct-effect employment multiplier = total jobs impact

Source: („Input-Output Models for Impact Analysis: Suggestions for Practitioners Using RIMS II Multipliers" by Rebecca Bess and Zoë O. Ambargis, 2011)

[26] In order to use the final-demand multipliers, we need to assume that a change in final demand is due to a change in gross output (Bess and Ambargis, 2011).
[27] In order to use the direct-effects multipliers, we need to have an estimate of the change in final-demand earnings as well as an estimate of the change in final-demand jobs (Bess and Ambargis, 2011).

Table 4.5: The four final-demand multipliers

Multiplier	Definition	Application
Output	Total industry output per $1 change in final demand	Final-demand output x final-demand multiplier = total gross output impact
Value Added	Total value added per $1 change in final demand	Final-demand output x final-demand value-added multiplier = total value-added impact
Earnings	Total household earnings per $1 change in final demand	Final-demand output x final-demand earnings multiplier = total earnings impact
Employment	Total number of jobs per $1 million change in final demand	Final-demand output x final-demand employment multiplier = total jobs impact

Source: („Input-Output Models for Impact Analysis: Suggestions for Practitioners Using RIMS II Multipliers" by Rebecca Bess and Zoë O. Ambargis, 2011)

Despite the fact that both types of multipliers are able to solve our issue with the calculation of the total impact measure, we chose to use the final-demand multipliers. This is due to the fact that they offer us a larger variety of multipliers, which can become convenient later on.

As for the remainder of this chapter, we will show how we can calculate the final-demand multipliers in Excel. But before we start, we need to stress that both the Open and the Closed Leontief model will follow very similar calculation procedures[28]. Therefore, we will only explain the calculation procedure of the Open Leontief model.

4.6 Calculation of Multipliers in an Open Leontief Model

Prior to any form of calculation, we need to make sure that our input-output tables are set up in a user-friendly fashion, which will allow us and others to follow and to reproduce our work at ease. Now, in order to calculate the final-demand multipliers, we need to calculate a few additional matrices (Input-Output Matrix A, Identity Matrix I, Leontief Matrix I-A, and open Leontief Inverse Matrix $(I-A)^{-1}$).

[28] The only difference in the calculation procedure between those two models is that in the Closed Leontief model, we need to take into account that households act as an additional industry.

The first matrix that we need to compute is the input-output matrix A, which will allow us to show much more inputs it takes to create an additional unit. Looking back at Figure 4.2, we can see that X_i represents the total production of the ith sector, X_{ij} shows the amount of goods and services that the jth sector used from the ith sector in order to produce the commodity, and X_j shows how much from the ith sector's production is being used by the jth sector. In other words, X_{ij} embodies the intermediate use of goods and services that were produced by the ith sector.

Now, in order to attain the technical input-output coefficient, we have to do the following operation:

$$X_{ij} / X_{j,} = a_{ij} \text{ , where } i, j = 1, 2, ..., n \qquad (4.1)^{29}$$

Equation 4.1 allows us to denote matrix A, which represents the complete set of technical input-output coefficients of all sectors of the economy. Matrix A is also known as the structural matrix, due to the fact that the matrix itself as well as the corresponding input-output table is arranged in a rectangular shape (Tanaka, 2011).

The next matrix, the identity matrix I, does not require any actual calculations. In fact, all we need to do is to create an identity matrix with the same size n as the structural matrix A. This is important, since a difference in size would lead to miscalculations.

In order to get the Leontief matrix, we need to substract the structural matrix A from the Identity matrix I:

$$(I\text{-}A) \qquad (4.2)^{30}$$

The last matrix that we need to create is the open Leontief Inverse matrix[31], or also known as multiplier matrix. This matrix can show us the direct as well as the indirect production requirements in order to satisfy the final demand of each sector. In order to get this matrix, we need to find out whether the Leontief matrix is invertible or not. We can determine whether the inverse of the Leontief matrix exists or not, by looking whether the assumption in Equation 4.3 holds.

$$\text{If } |I\text{-}A| \neq 0, \text{ then the inverse of the Leontief matrix exists.} \qquad (4.3)^{32}$$

[29] a_{ij} shows the ratio between input used, i, to produce output, j.

[30] $I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $A = \begin{bmatrix} a11 & a12 & \cdots & a1n \\ a21 & a22 & \cdots & a2n \\ \vdots & \vdots & \ddots & \vdots \\ an1 & an2 & \cdots & ann \end{bmatrix}$

[31] The results of the open Leontief Inverse matrix account for the first-round effects, while the closed Leontief Inverse matrix, $(1\text{-}B)^{-1}$, will allow us to calculate the cummulative effects, once all secondary effects have been accounted for.

[32] In other words, we need to show that the Leontief matrix is nonsingular – the determinant is nonzero.

Now, by inverting the Leontief matrix,

$$(\text{I-A})^{-1} \qquad (4.4)$$

we get the open Leontief Inverse matrix. In addition, we could check whether the structural matrix A statisfies the Hawkins-Simon condition[33], $X = (I - A)^{-1} Y$.

Once we estimated all of these matrices, we should be able to compute the final-demand multipliers – Output multiplier (4.5), Value Added multiplier (4.6), Earnings multiplier (4.7), and Employment multiplier (4.8). In fact, when we take a look at Equation 4.5, we can see that it is the open Leontief Inverse matrix.

$$M_y = (\text{I-A})^{-1} \qquad (4.5)$$

$$M_r = r\,(\text{I-A})^{-1} \qquad (4.6)^{34}$$

$$M_w = w\,(\text{I-A})^{-1} \qquad (4.7)^{35}$$

$$M_e = e\,(\text{I-A})^{-1} \qquad (4.8)^{36}$$

In the next chapter, we will be presenting the results from the calculations of Output multiplier (4.5), Value Added multiplier (4.6), and Earnings multiplier (4.7), for the five countries, Germany, Czech Republic, USA, China, and Russia, and two economic areas, EU25 and Rest of the World during the years 2005-2011. Unfortunately, we are not able to show results for the Employment multiplier (4.8), due to the fact that we couldn't gather the relevant information – employment data from each industry, showing the payments to foreigners. However, we were able to retrieve some information regarding changes in total output[37] as well as skill-specific job productivity[38] for Germany and the Czech Republic during the years 2005-2009.

There are 3 types of skill-specific jobs - high-skilled, medium-skilled, and low-skilled jobs.

- *High-skilled jobs* – The employee had to go through a long and special training in order to able to work in this profession. In fact, this training allows them to work independently and efficiently. Examples of high-skilled jobs are: doctors,

[33] Where X refers to the Output column vector (endogenous), Y refers to the Final-demand column vector (exogenous), and (I-A) −1 is the open Leontief Inverse matrix (endogenous).
[34] The letter r refers to the share of interest and profits in the output of the jth sector.
[35] The letter w refers to the share of wages in the output of the jth sector.
[36] The letter e refers to the share of imports (payments to foreigners) in the output of the jth sector.
[37] Gross Output per Total Hours Worked by Employees
[38] Gross Output per Hours worked by high-skilled, medium-skilled, and low-skilled persons engaged (The official WIOD definition of skills can be found in the appendix, Table 4.6)

lawyers, electricians, law enforcement officers, etc.

- *Medium-skilled jobs* - This type of job require that the employee has some skill as well as goes through a little training due to the fact that the job is a bit more complex than the low-skilled jobs. Examples of medium-skilled jobs are: truck drivers, customer service representatives, assembly worker, etc.
- *Low- skilled jobs* - The employee is not required to go through a special training in order to performing the job/task. However, the job might require the employee to be familiar with the environment. Examples of low-skilled jobs are: farm laborers, grocery clerks, hotel maids, cleaners, etc.

Chapter 5

Results

This part of the thesis is divided into two sections in order to address the results from our multiplier as well as productivity calculations in different aspects. While the first section will focus on showing the results of a simulated demand shock on the German automobile industry, the second section concentrates on showing the results of a sensitivity analysis of the German economy and its connection to productivity.

5.1 Effects of a demand shock in the automobile industry on Germany and other countries

Besides showing the results from simulating a demand shock on the German automobile industry, this section is intended to provide an answer to the first question: How did the output level of Germany, the Czech Republic, and the other countries changed due to the introduction of the car scrappage program?

In order to answer this question, we decided that it would be best to simulate a demand shock on the German automobile industry using the final-demand multipliers. More precisely, using two different scenarios we calculate the case when government increases the demand for Transport equipment (sector c15) by $1 000 millions (1 billion US$[39]). The assumption that separates scenario 1 from scenario 2 is with regards to how the increased demand is divided among the countries. While in scenario 1 we assume that there are no import leakages, we allow for proportional import leakages in scenario 2. Understanding the meaning of import leakages is quite crucial for the understanding of this simulation. Therefore, we will briefly describe what both scenarios imply/represent. Assuming in scenario 1 that there are no import leakages implies that all the extra money is spent on cars that were produced in Germany, while if we allow for proportional import leakages like in scenario 2, then this means that the additional German demand is being met by a combination of higher domestic output and imports (with shares of domestic and foreign purchases being preserved). Therefore, we can see that depending on the scenario, there can be quite a difference with regard to the demand for certain domestic or foreign car brands.

[39] Increasing the demand for this sector by 1 000 millions of US$ seemed suitable to us, since the budget of the German program was 7 billion US$ in 2009. Therefore, simulating a 1 billion US$ demand shock should bring meaningful results.

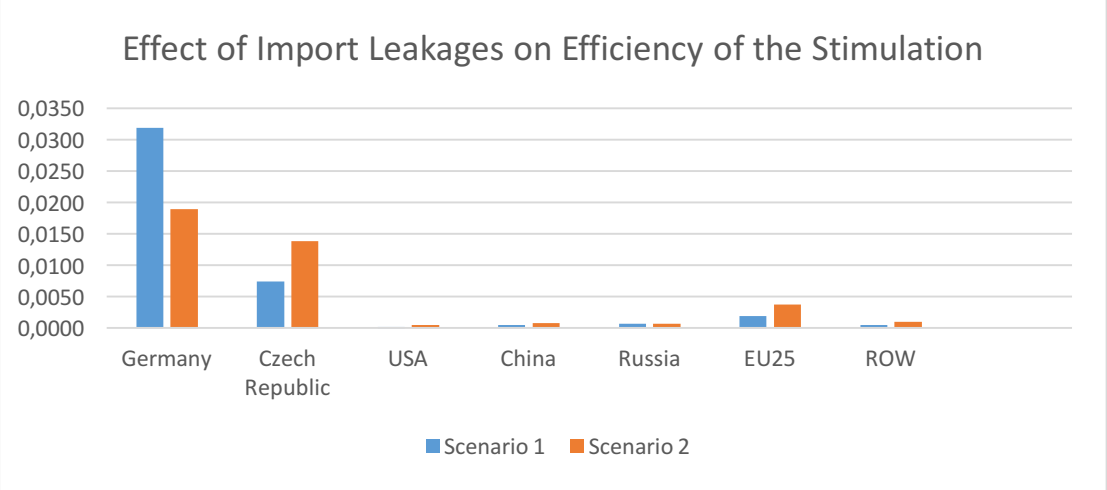
As a matter of fact, the results from both scenarios can be found in Table 5.1 and Figure 5.2. While Table 5.1 shows the minimum, maximum and average effects of the two scenarios for the years 2005 to 2011, Figure 5.2 displays in the form of a graph the sizes of the two scenarios for the year 2009 – the year in which the car scrappage program took place in Germany.

Table 5.1: The Min., Max. and Avg. Effects of Scenario 1 and 2 during the Years 2005 to 2011

	Scenario 1			**Scenario 2**		
Country	Min.	Max.	Avg.	Min.	Max.	Avg.
Germany	0.0271	0.0369	0.0311	0.0154	0.0208	0.0178
Czech Republic	0.0065	0.0098	0.0077	0.0093	0.0145	0.0124
USA	0.0002	0.0002	0.0002	0.0005	0.0008	0.0006
China	0.0004	0.0005	0.0005	0.0008	0.001	0.0009
Russia	0.0006	0.0012	0.0009	0.0006	0.0012	0.0008
EU25	0.0017	0.0022	0.0019	0.0034	0.0048	0.0039
Row	0.0004	0.0006	0.0005	0.0008	0.0013	0.0010

Notes: Please keep in mind that these numbers are already in percentages and that these numbers are a result of a shock which happened only in Germany.

Figure 5.2: The Effect of Import leakages on all countries for the Year 2009



Notes: Please keep in mind that these numbers are a result of a shock which happened only in Germany.

Germany

The first thing that we can see once we take a look at Table 5.1 and Figure 5.2 is that the effect on the German automobile industry seems to be much larger than on any other country for both scenarios. One reason for this could be that German cars are more favored

than foreign brands among Germans. In fact, the BAFA (2010) was able to reveal and prove this tendency as they discovered that German automobile producers, especially Volkswagen and Opel, were the ones that were demanded the most during the car scrappage program, followed by Škoda. A second reason, which however is a bit less likely to be the case of Germany, is that this policy was explicitly designed to help local car producers more than others. It is less likely to be the second reason since as Germany is a EU member country and such policy would violate some of the casic principles of EU integration.

In addition, we can observe that for all countries and economic areas except Germany the second scenario would lead to a higher effect with regards to efficiency of a demand shock. This is trivial since we allow for import leakages in scenario 2, but not in scenario 1. Therefore, Germans are no longer restricted to purchasing German brands, but are free to purchase the car brand that they favor.

When we take a closer look at the numbers in Table 5.1, we can see that the true effects on efficiency might be hard to measure with regards to GDP, since the effects are so small, despite already being displayed in percentage points. However, despite the effects being so small, we need to keep in mind that these numbers are final-demand multipliers. Therefore, in order to see the true effect on the economy, we would need to multiply them by the amount the demand increased, 1 billion US$. The results are shown in Table 5.3.

Table 5.3: True Effects of the Final-demand multipliers for the Years 2005 to 2011 (in US $)

	Scenario 1			**Scenario 2**		
Country	Min.	Max.	Avg.	Min.	Max.	Avg.
Germany	271 000	369 000	311 000	154 000	208 000	178 000
Czech Republic	65 000	98 000	77 000	93 000	145 000	124 000
USA	2 000	2 000	2 000	5 000	8 000	6 000
China	4 000	5 000	5 000	8 000	10 000	9 000
Russia	6 000	12 000	9 000	6 000	12 000	8 000
EU25	17 000	22 000	19 000	34 000	48 000	39 000
Row	4 000	6 000	5 000	8 000	13 000	10 000

In fact, we can see from Table 5.3, that once the calculations are done, the numbers are quite big compared to the financial investment that it required. Therefore, we can see a small investment from the German government into the automobile industry can have quite decent effects on the automobile industry as well as on the economy as a whole. In fact, this investment

can have two benefits: showing that the government cares about this sector's performance as well as transparency and providing a lucrative investment opportunity to foreign investors into a continuously advancing industry.

The Czech Republic

While the first part of this section looked at the data from the German point of view this part is regarding it from the Czech point of view. The fact that might be surprising at first is that the Czech Republic is doing much better than the rest of the EU25 with regards to benefitting from the German fiscal policy. However, we need to remember that the German and Czech automobile industries are interlinked. By that we refer to the fact that Škoda, famous Czech car brand, is owned by Volkswagen, famous German brand. Therefore, any adjustments done to the German automobile industry will eventually have an impact on the Czech market. Despite that linkage, the numbers still surprised us quite a bit, since we did not imagine that the effects of the demand shock would be that large and so much different from other markets, such as US, Chinese, or EU25.

5.2 The Sensitivity to Shocks in different Sectors

While the first section examined the effects of a simulated demand shock on the automobile industry, this section is taking a closer look at how sensitive certain sectors of the German economy were during the years 2005 to 2011 in an attempt to evaluate whether there were any other effective alternatives to the car scrappage program.

In order to get some idea about the sensitivity levels, we created a hypothetical scenario in which we assumed that the German government has spent the same amount of money in all of the 35 sectors. Although, the total value of the shock could have been changed, we thought that it might be more convenient to stick to 1 billion US$. The results from our calculations can be found in Table 5.4.

For simplicity, we decided to display only the Water transport, Food, Berverages and Tobacco, Transport equipment, Other Supporting and Auxiliary Transport Activities (Activities of Travel Agencies), and Financial Intermediation sectors, as they seem to be the most stable sectors with regards to ranking for this specific time period.

Table 5.4: Ranking of the German sector's Sensitivity levels for the Years 2005 to 2011

Sector	Water Transport	Food, Beverages and Tobacco	Transport Equipment	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	Financial Intermediation
2005	0.0376 (2nd)	0.0391 (1st)	0.0369 (4th)	0.0370 (3rd)	0.0365 (5th)
2006	0.0377 (1st)	0.0366 (2nd)	0.0342 (5th)	0.0342 (4th)	0.0344 (3rd)
2007	0.0329 (1st)	0.0317 (2nd)	0.0297 (6th)	0.0300 (4th)	0.0304 (3rd)
2008	0.0298 (1st)	0.0290 (2nd)	0.0274 (5th)	0.0271 (6th)	0.0282 (3rd)
2009	0.0339 (1st)	0.0328 (2nd)	0.0319 (3rd)	0.0309 (6th)	0.0317 (4th)
2010	0.0339 (1st)	0.0316 (2nd)	0.0304 (5th)	0.0308 (4th)	0.0303 (6th)
2011	0.0305 (1st)	0.0280 (3rd)	0.0271 (6th)	0.0276 (4th)	0.0270 (7th)

Notes: We rounded the results to 4 decimals and that the number in the brackets represents the ranking in the specific year out of all 35 sectors.

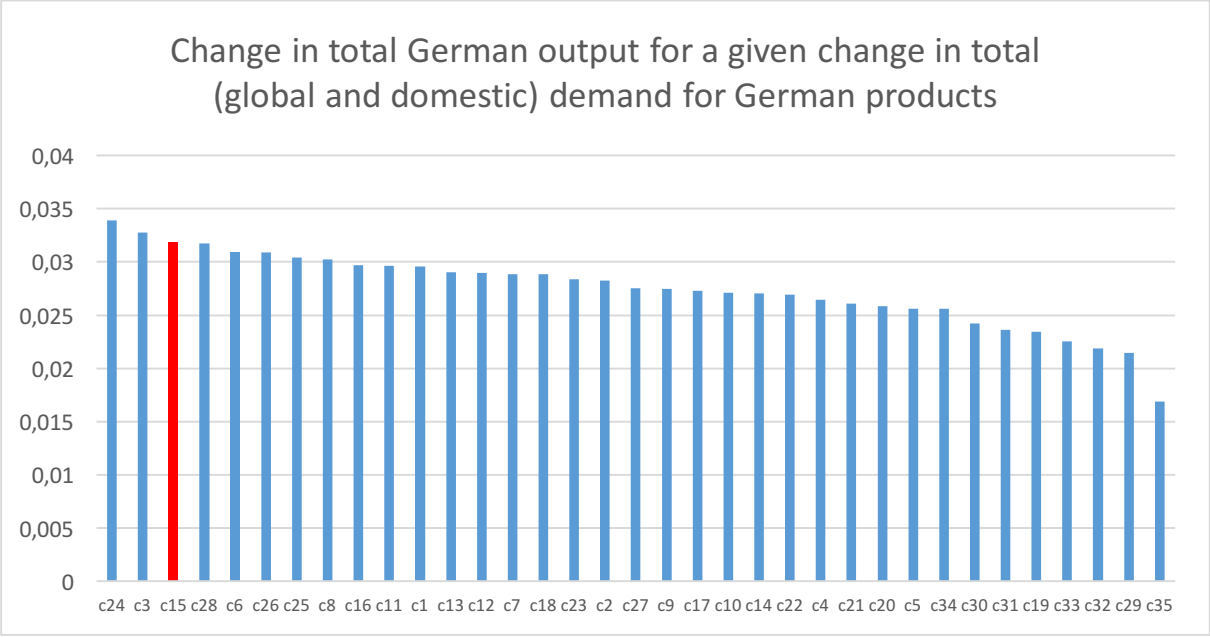
However, in order to complete the picture of the sensitivity level for 2009, we decided to add Table 5.5 and Figure 5.6, which display the sensitivity levels of all 35 sectors during 2009.

Table 5.5: The Sensitivity levels of all 35 Sectors for the Year 2009

Code	Sector	Sector Classification	Sensitivity level
61	Water Transport	c24	0.033925598
15t16	Food, Beverages and Tobacco	c3	0.032787688
34t35	Transport Equipment	c15	0.031871522
J	Financial Intermediation	c28	0.031712858
20	Wood and Products of Wood and Cork	c6	0.030933063
63	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	c26	0.030900748
62	Air Transport	c25	0.030401964
23	Coke, Refined Petroleum and Nuclear Fuel	c8	0.030263672
36t37	Manufacturing, Nec; Recycling	c16	0.029706289
26	Other Non-Metallic Mineral	c11	0.029659827
AtB	Agriculture, Hunting, Forestry and Fishing	c1	0.029591968
29	Machinery, Nec	c13	0.029007355
27t28	Basic Metals and Fabricated Metal	c12	0.02898156
21t22	Pulp, Paper, Paper , Printing and Publishing	c7	0.028876728
F	Construction	c18	0.028853458
60	Inland Transport	c23	0.028352266
C	Mining and Quarrying	c2	0.028282378
64	Post and Telecommunications	c27	0.027523288
24	Chemicals and Chemical Products	c9	0.027500055
E	Electricity, Gas and Water Supply	c17	0.027321992
25	Rubber and Plastics	c10	0.027104114
30t33	Electrical and Optical Equipment	c14	0.027059471
H	Hotels and Restaurants	c22	0.026937978
17t18	Textiles and Textile Products	c4	0.026453258
52	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	c21	0.026119658
51	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	c20	0.025864352
19	Leather, Leather and Footwear	c5	0.025597036
O	Other Community, Social and Personal Services	c34	0.025587698
71t74	Renting of M&Eq and Other Business Activities	c30	0.024233357

L	Public Admin and Defence; Compulsory Social Security	c31	0.023605552
50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	c19	0.02344608
N	Health and Social Work	c33	0.022549597
M	Education	c32	0.021895218
70	Real Estate Activities	c29	0.021450395
P	Private Households with Employed Persons	c35	0.016910443

Figure 5.6: The Change in Total German Output caused by a Simulated Demand Shock



Once we take a closer look at Table 5.4, we can see that the Transport equipment sector does quite well in terms of keeping a high ranking level over the years with regards to sensitivity. Although, its ranking flucuates from rank 3 to rank 6 over the years, Table 5.5 and Figure 5.6 show that the Transport equipment sector reaches its highest rank, rank 3, during 2009. From macroeconomics, we know that if we want to influence the demand for a certain commodity or increase consumption in general, then the sensitivity level/elasticity of that particular commodity/sector is quite important. If the commodity/industry has a high sensitivity level, such as the Transport equipment sector did in 2009, a small price adjustment can cause a huge increase in demand for that commodity. This was, in particular, the case with the car scrappage program, as a small price adjustment resulted in the purchase of 2 million new cars.

Although, the Transport equipment sector was the sector that received a program to support its consumption, there were two sectors - the Water transport and the Food, Beverages

and Tobacco sector, which achieved a higher sensitivity ranking compared to the Transport equipment sector during 2009. This observation led us to question whether investing into the car scrappage program was truly the best option for the German government or whether they should have rather implemented a program focused on one of these two sectors?

Answering that question might not be as easy as one might think, since if we look at Table 5.7, which displays our compiled and calculated productivity data for these three sectors, we can see that the Transport sector does not outperform the water transport sector in terms of productivitiy. However, it does clearly outperform the Food, Beverages and Tobacco sector in all aspects of productivity.

Table 5.7: Productivity levels of the Water transport, Food, Beverages and Tobacco, and Transport equipment sector for the Year 2009

Sector	**Total productivity**	**Low-skilled jobs productivity**	**Medium-skilled jobs productivity**	**High-skilled jobs productivity**
Water transport	835.2	132.2	585.5	117.4
Food, Beverages and Tobacco	114.0	18.1	69.1	26.8
Transport equipment	236.5	37.6	143.3	55.7

Although, Figure 5.7 shows that the Transport sector has the second highest productivity level from those three sectors, it did not really help us to explain why the German government decided to implement a program that was focused on the automobile industry - transport equipment sector. So why did the government went with the automobile industry?

One reason might be that the Water transport and Food, Beverages and Tobacco sector do not seem to provide any investment options that would promote financial stability, gain consumer's confidence and increase consumption at the same time. However, we know from hindsight that the car scrappage program was able to increase the consumption in 2009 by 2 million new cars, while at the same time reduce emissions by nearly 50% (BAFA 2010), secure jobs and promote technological advances.

Another reason that could have influenced the German government decision might be the cost involved in a program that would increase the consumption for a certain commodity. In order to increasing the demand for water transport, the option for the government are quite limited, in fact, the only option would be to improve the intra-country river transporation. This can be accomplished by building new channels and harbors or renewing old channels. However, this can be quite costly and might cause a lot of bureaucratic issues/paper work since

most channels are historically protected. In respect to the Food, Beverages and Tobacco industry it is obvious that the government might not want to issue a program that would cause an increase in the consumption for those commodities due to moral and ethical reasons.

A third reason might have been that it would be hard to change the people's consumption habits for products[40], which exhibit a higher elasticity of end-user demand than others. In the case of those two sector's commodities, it is questionable whether additional money would provoke the people to consume more from either one of those two industries. That is simply because people in general do not change their consumptions habits so quickly as to start consuming more shipping goods or alcohol/tobacco goods, even if they would have the money available to them. As a matter of fact, non-heavy drinkers would be more likely to save the money due to the fact that they are aware of the alcoholism-related health effects, while in the case of heavy drinkers, the extra money would rather be used to increase their alcohol consumption. While with regards to the automobile industry, changing the people's consumption habits seems to be more promising as they would simply push they planned-purchases a few month/years ahead due to the car scrappage program. Another reason why the change in the automobile industry might have been more smoothly compared to the other two industries could be the fact that the people saw the chance to get a more fuel-efficient car while at the same time profiting from the subsidy. Therefore, investing into the automobile industry might be more promising with regards to the other options available to the German government.

The fourth reason why the German government might have focused on the automobile industry first is the fact that the automobile industry has a much higher level of employment compared to the Water transport or Food, Beverages, and Tobacco industry. As a matter of fact, the exact numbers can be see in Table 5.8, which displays the number of employees that each sector had during 2009.

[40] While the water transport sector mostly provides the service of shipping goods, the Food, Beverages and Tobacco sector provides commodities of inelastic demand – alcohol, tobacco, etc. In fact, we are assuming that the products from the Water transport sector are likely to be quite low with regards to elasticity.

Table 5.8: Employment level of the Water transport, Food, Beverages, and Tobacco and Transport equipment industry for the Year 2009

Sector	**Number of employees (thousands)**
Water transport	23
Food, Beverages and Tobacco	862
Transport equipment	944

That observation is quite relevant, since it shows an additional benefit of the car scrappage program – secure jobs and provide safety. By that we refer to the fact that, while the financial crisis of 2007/2008 just took place and the effects slowly started to show the German economy, the car scrappage program allowed the German government to help as much people as possible, while at the same time fight the effects of the crisis.

The fifth reason could be that it might not be as easy as it was for the automobile industry to create an exogenous one-time increase in the demand for either Water transport and Food, Beverages and Tobacco industry's commodity.

The last reason could be that both of those two industries would most likely show no longer-term effects as a result to a short-term exogenous increase in demand. In other words, it might be the case that, although, there is an increase in food consumption in the short-term, the demand for food would decrease shortly thereafter, since the basic demand drivers were not changed with any government demand-increasing program. In fact, we believe that this would be the same with regards to the Water transport industry. While we might not observe any long-term effects on either one of those two industries, we are pretty confident that this is not the case for the automobile industry. In fact, we believe that an increase in the demand for cars today will spur additional production of cars as well as inspire technological development in this industry. Although, there should be a drop in the demand for cars (durable good) after an earlier acceleration caused by the subsidy program, we would expect that there should be an overall shortening of the mean age of the durables – long-term effect. And, more importantly, the learning curve of accelerated consumption of technology-based goods increases long-term consumption due to the learning curve effects (and economic efficiencies gained). Thus, the increased production and delivery of cars as well as upstream products will have some small effect on the efficiency of improvement yielding longer-term, positive economic benefits.

Therefore, we can clearly see that despite there being other sectors with a higher sensitivity level, the automobile industry was the most one industry that seemed to be the most reasonable

option for the german government in order to attain the goals as well as fight the effects of the financial crisis of 2007/2008.

Chapter 6

Conclusion

Without a doubt the economic crisis of 2007/2008 caused severe damage to countries worldwide as countries experienced a fall in GDP, production, trade, and employment. Despite the severity of the crisis, some countries seemed to recover quickly, while others needed a much longer time to recover from the impacts of the economic crisis. Inpite of the diversity in the speed of recovery between the countries, two things remained the same - the effects are long lasting in the form of a country's public debt and a pemanent loss of potential output.

But how come that some countries decided to respond quicker to the effects of the economic crisis of 2007/2008 than other countries? We discovered that the difference in speed of responding to the effects of the crisis occured due to several reasons: diversity in institutions (industry structure, size, etc.), economic zones, and free riding. Free riding is the one that stands out the most of these three potential reasons. This is simply because it implies that some countries tried to benefit from others, who took the risk and sufficed their financial reserves in order to find an efficient treatment for recovery. However, this might not always be beneficial, since we discovered that it is hard for some countries to find the treament that suits their specific needs. Therefore, it was often better for countries to follow the trial and error principle, in case they would have the financial reserves available to them.

Although we can see that it is not easy to find a general cure for this specific issue. One thing, however, was the main focus for all countries: to restore consumer's confidence in the financial markets and to have positive economic growth. From a macroeconomic point of view, economists believed that this can be achieved via a stabilisation policy, which can be done via monetary or fiscal policy. Despite the fact that there are in general two option, fiscal policy seemed to be the only option available to Germany out of these two, due to the fact that Germany is part of a monetary union – fixed exchange rate regime and a high mobility of capital.

Fiscal policy can occur in two forms: government spending (direct purchases or transfers) and tax cuts. While both forms have their advantages and disadvantages, Germany decided to use a government spending program in the form of direct purchases. This program started January 19th, 2009, and was known as the car scrappage program (in German "Abwrackprämie"). While the program seemed to be well-funded and promote economic growth along other things, it only lasted till September 2009, when the €7 billion budget was exhausted. Depite the fact

that the program was so short-lived, it encouraged the purchase of roughly 2 million new cars (Kaul *et al.* 2012). Especially the small and upper small car market segments seemed to have benefited greatly from the program, as they formed roughly 84% of the newly registered cars (Böckers, Heimeshoff and Müller 2012).

In fact, the BAFA[41] (2010) claimed in their final report that this program should inspire other countries to follow similar policies, due to the fact that it was successful in spuring domestic demand as well as reducing CO_2 emissions. With regards to emissions, the IfEU[42] dicovered that the program was responsible for a decrease of CO_2 emissions by nearly 50% (BAFA 2010). Despite the fact that there is already a lot of evidence showing that the program was a success, we wanted to get our own impression about the program and therefore attempted to evaluate it via Leontief's input-output analysis. Although we are aware of the fact that this model will not solve the issue of finding a general treament, using this model seemed to be lucrative as several economists applied the model for similar scenarios and got strong results. In fact, the input-output model enables the user to study the industrial structure of the domestic and foreign markets, as well as to analyse trade influence and sector interdependence via displaying a country's economy as a whole. Thus, we believe that the model should be well-suited for the purpose of this thesis - to study the effects of the program on Germany and its neighboring countries with respect to output and employment. As a matter of fact, once we calculated final-demand multipliers, the results proved that the car scrappage program had been very successful with regards to stimulating the national automobile industry. In fact, Tble 5.1 and Figure 5.2 show that even if we allow for import leakages to occur, the German car producers are the ones that benefit the most from the car scrappage program. In addition, Table 5.3 shows that in terms of sensitivity level ranking the automobile sector is among the top options during 2009. In fact, a high level of sensitivity allows the government to stimulate the automobile industry and other sectors of the economy quite a lot with just a small amount of financial investment. Lastly, we provided evidence that showed that the automobile industry was the best option for the German government to invest in during 2009, despite the fact that there were two alternative options – water transport and food, beverages, and tobacco sector.

Although we discovered quite a lot in our study, we were not able to study the long terms effects of the German car scrappage program on other aspects of the German economy, such

[41] BAFA is the acronym for "Bundesamt für Wirtschaft und Ausfuhrkontrolle" (Ministry of Economic Affairs).
[42] IfEU is the acronym for "Institut für Energie- und Umweltforschung Heidelberg GmbH" (Insitute for Energy and Environmental research). In fact, this study was created for the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety.

as trade impacts, practices of other programs, etc. Therefore, our research suggests continued investigation on this program and its effects will yield further insights.

In addition, the CPA classifications lacked to provide us with data relevant to study, which type/brand of cars was bought the most or whether the fact that Germans experienced small budgets, signal motives, and rising oil price had anything to do with their decision-making. As for the brands of cars, we refer you to take a look at the final report of BAFA. This report lists the total number of annual and new cars that were bought during the program as well as the number of old cars that were scrapped in order to attain the subsidy according to their brand, size, and environmental efficiency. However, as for the incentives behind the purchases, we lack any information. Thus it could be interesting for future research to find out whether people in Germany bought small cars since they had small budgets, tried to avoid signaling or showing that they had money, rising oil prices or truly because of the car scrappage program.

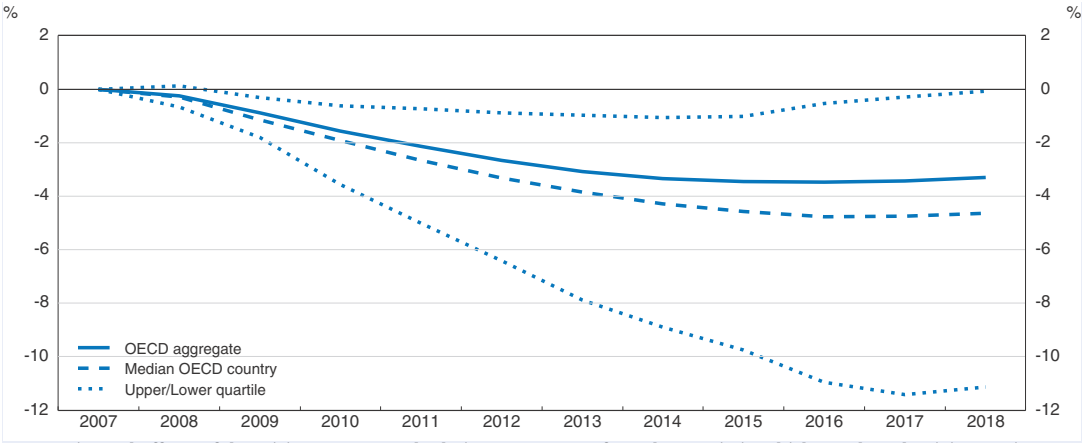
Appendix

Table 1.1: General government gross financial liabilities as a percentage of GDP

	2008	2009	2010	2011	2012	2013	2014	2015
Australia	13.9	19.4	23.6	27.0	32.1	33.1	35.2	35.9
Austria	68.7	74.3	78.8	80.6	86.0	83.4	90.0	89.5
Belgium	92.6	101.0	100.9	104.1	106.4	106.7	106.8	105.4
Canada	74.7	87.4	89.5	93.6	96.1	93.6	94.2	93.6
Czech Republic	34.4	40.8	45.2	48.2	55.7	57.1	58.8	60.9
Denmark	41.4	49.3	53.1	59.9	59.3	55.2	56.5	59.3
Estonia	8.5	12.6	12.4	9.6	13.3	13.1	13.0	12.7
Finland	40.3	51.8	57.9	58.2	64.0	66.4	69.3	70.1
France	79.3	91.4	95.7	99.3	109.3	112.6	115.1	116.1
Germany	69.9	77.5	86.2	85.8	88.5	85.9	83.9	79.8
Greece	122.5	138.3	157.3	179.9	167.5	186.0	188.7	188.2
Hungary	77.2	86.4	87.7	86.8	90.0	89.4	90.3	90.1
Iceland	76.4	94.5	100.1	106.8	103.7	97.9	96.0	91.3
Ireland	50.1	71.1	88.5	103.9	127.8	134.6	133.1	132.0
Israel[1]	72.9	75.3	71.5	69.7	68.2	67.8	67.6	67.0
Italy	118.9	132.4	131.1	124.0	142.2	145.5	147.2	147.4
Japan	171.1	188.7	193.3	209.5	216.5	224.6	229.6	232.5
Korea	28.3	31.0	31.8	33.3	34.8	36.5	37.9	39.0
Luxembourg	19.3	19.2	26.2	26.3	30.2	30.3	31.6	33.5
Netherlands	64.8	67.6	71.9	76.1	82.7	86.2	87.5	87.7
New Zealand	28.7	34.0	37.8	41.3	42.4	40.6	39.3	38.1
Norway	55.2	49.0	49.3	33.9	34.7	35.6	36.7	39.6
Poland	55.5	57.6	62.2	63.0	62.3	63.8	56.8	58.4
Portugal	80.8	94.0	104.0	118.4	134.6	139.4	141.3	142.2
Slovak Republic	32.2	40.4	45.9	48.3	56.9	59.3	59.1	60.1
Slovenia	28.9	43.3	47.6	51.2	61.6	80.5	85.9	89.7
Spain	48.0	63.3	68.4	78.8	92.6	104.0	108.5	111.5
Sweden	48.3	50.2	47.3	47.6	46.7	47.1	48.5	48.3
Switzerland	48.3	47.5	46.2	46.3	46.5	46.2	45.9	45.3
United Kingdom	57.3	72.1	81.7	97.1	101.6	99.3	101.7	103.1
United States	72.6	85.8	94.6	98.8	102.1	104.3	106.2	106.5
Euro area (15 countries)	78.0	88.8	93.9	95.9	104.4	106.7	107.7	106.9
OECD-Total	79.9	91.2	97.5	102.1	107.1	109.5	111.1	111.2

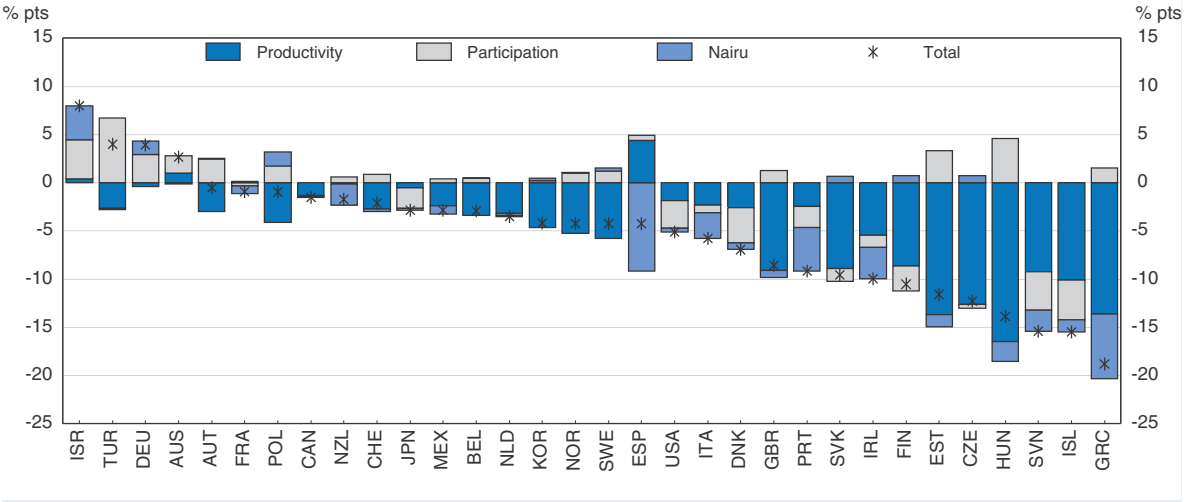
Source: (OECD Economic Outlook No. 95, 2014)

Figure 1.2: Percentage reduction in potential output per capita relative to a pre-crisis counter-factual scenario



Source[43]*:* (OECD Economic Outlook 95 long-term database, 2014)

Figure 1.3: Estimated effect of productivity, participation and Nairu on the potential output per capita of individual OECD countries



Source: (OECD Economic Outlook 95 long-term database, 2014)

[43] *Remarks:* Estimated effects of the crisis are measured relative to a counter-factual scenario in which trend productivity continues at its pre-crisis (2000-07) trend growth rate; the structural unemployment and trend participation rates remain at their pre-crisis (2007) levels.

Table 1.4: The pros and cons of Monetary and Fiscal policy

Monetary policy		**Fiscal policy**	
Pros	**Cons**	**Pros**	**Cons**
Controlling Inflation via interest rate targeting	Risk of Hyperinflation	Government spending towards specific industry	Budget Deficit
Can be implemented quite easily	Cannot be specified on individual industries	Discourage Negative Externalities via taxation	Taxation due to political motivation
Central banks act independently and remain politically neutral	Technical limitations		Long Time lag
Weaker currency can boost exports			
Short Time lag			

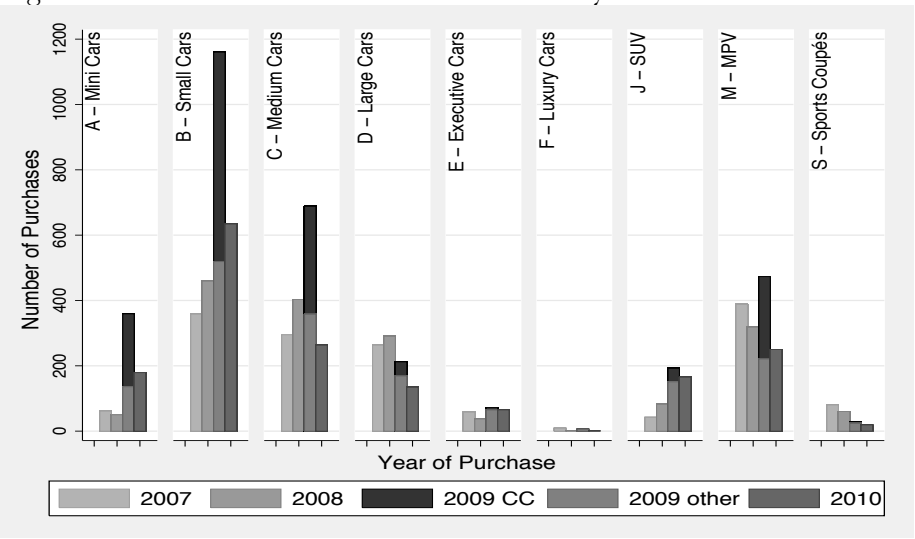
Table 2.1: Summary of Monetary and Fiscal policy effects in open economies

Small open economy, perfect capital mobility		
	Fixed exchange rates	**Flexible exchange rates**
Monetary policy	Impotent, no independent effect, consistent with trilemma	Strong, exchange rate impact augments direct effect of policy on domestic spending
Fiscal policy	Strong, fiscal policy gains control over money supply	Impotent, international crowding out augments domestic crowding out

Large open economy, imperfect capital mobility		
	Fixed exchange rates	**Flexible exchange rates**
Monetary policy	Impotent, same as in small open economy	Strong, with more exchnage rate effect than in small open economy
Fiscal policy	Strong, but not as effective as in small open economy	Impotent, as in small open economy

Source: (Any open economics textbook, such as "Principles of Economics" by Mankiw, 2011)

Figure 3.1: Number of Purchases over Time by EU-Vehicle Class



Source: [44]("The Incidence of Cash for Clunkers" by Kaul *et al.*, 2012)

Table 3.2: Number of Purchases over Month of all Years, 2009 by CC

	Year of Purchase and Clunker's Prime				
Month of Purchase	**2007**	**2008**	**2009 Non-CC**	**2009 CC**	**2010**
1	103	109	115	25	101
2	85	132	139	93	120
3	162	175	183	206	230
4	154	225	157	200	159
5	147	159	115	221	183
6	142	172	156	198	166
7	118	149	129	192	133
8	116	85	107	150	133
9	140	115	136	102	129
10	109	145	145	100	143
11	134	120	137	41	114
12	144	115	130	13	100
Total	1554	1701	1649	1541	1711

Source: ("The Incidence of Cash for Clunkers" by Kaul *et al.*, 2012)

[44] *Remarks:* Note: A, B, C, D, E, F, J, M, S are auto segments according to the EU-car classification. CC is a dummy variable indicating whether the buyer of a car received the scrappage subsidy (CC = 1). 2009 CC are car purchases in 2009 involving the scrappage subsidy, 2009 others are non-subsidized purchases. SUV stands for Sport Utility Vehicle, MPV for Multi Purpose Vehicle

Table 4.6: Definition of skills in WIOD

WIOD skill-type	1997 ISCED level	1997 ISCED level description
Low	1	Primary education or first stage of basic education
Low	2	Lower secondary or second stage of basic education
Medium	3	(Upper) secondary education
Medium	4	Post-secondary non-tertiary education
High	5	First stage of tertiary education
High	6	Second stage of tertiary education

Source: ("The WIOD: Contents, Sources and Methods" by Timmer *et al.*, 2012)

Bibliography

Adda, J., & R. Cooper (2000): "The dynamics of car sales: A discrete choice approach" (No. w7785). National bureau of economic research.

Afonso, A. & M. S. Ricardo (2012): "The Macroeconomic Effects of Fiscal policy." Applied Economics 44(34): pp. 4439–4454.

Ait-Sahalia, Y., J. Andritzky, A. Jobst, S. Nowak, & N. Tamirisa (2012): "Market Response to Policy Initiatives during the Global Financial Crisis." Journal of International Economics 87: pp. 162–177.

Andersen, T. (2009): "Fiscal Policy and the Global Financial Crisis." Economic Working Paper.

Barrell, R., T. Fic, & I. Liadze (2009): "Fiscal Policy Effectiveness in the Banking Crisis." National Institute Economic Review 207: pp. 43–50.

Baumol, W. J. (2000): "What Marshall Didn't Know: On the Twentieth Century's Contributions to Economics." Quarterly Journal of Economics pp. 1–44.

Belongia, M. T., & P. N. Ireland (2015): "The Evolution of US Monetary Policy: 2000-2007" (No. 882). Boston College Department of Economics.

Bensaid, M., A. Ibourk, & A. Khellaf (2011): "Évaluation des emplois générés dans le cadre du Document de Stratégie de Croissance et de Réduction de la Pauvreté au Gabon." Document de travail de l'Emploi n° 80.

Bess, R., & Z. O. Ambargis (2011): "Input-output models for impact analysis: Suggestions for practitioners using RIMS II multipliers." In *50th Southern Regional Science Association Conference, New Orleans, Louisiana* (pp. 23-27).

Blanchard, O., C. Cottarelli, A. Spiimbergo, & S. Symansky (2009): "Fiscal Policy for the Crisis." London: Centre for Economic Policy Research.

Blanchard, O. & D. Leigh (2013): "Growth Forecast Errors and Fiscal Multipliers." National Bureau of Economic Research (No. w18779).

Bundesamt Für Wirtschaft Und Ausfuhrkontrolle (2010): "Abschlussbericht - Umweltprämie." Publication. Eschborn: BAFA. Print.

Böckers, V., U. Heimeshoff, & A. Müller (2012). "Pull-forward effects in the German car scrappage scheme: A time series approach." Econstor.

Caldara, D. & C. Kamps (2008): "What Are the Effects of Fiscal Policy Shocks? A VAR-Based Comparative Analysis." Working Paper Serioer, European Central Bank No. 877.

Cook, D. & M. Devereux (2011): "Sharing the Burden: Monetary and Fiscal Responses to a World Liquidity Trap." National Bureau of Economic Research (No. w17131).

Deysher, B., & D. Pickrell (1997): "Emissions reductions from vehicle retirement programs." *Transportation Research Record: Journal of the Transportation Research Board*, (1587), 121-127.

Deysher, E., & D. Pickrell (1997): "Estimating emissions reductions from vehicle retirement programs." *Final report, January 1992-December 1996* (No. PB--97-153795/XAB; DOT-VNTSC-FHWA--97-4). Department of Transportation, Cambridge, MA (United States). John A. Volpe National Transportation Systems Center.

Diamond, J. W. (2005): "Dynamic effects of extending the 2001 and 2003 income tax cuts." *International Tax and Public Finance*, *12*(2), 165-192.

Di Bitonto, S., M. Kolbe, & W. MacDougall (2012): "The Automotive Industry in Germany." Issue brief no. 2012/2013. Germany Trade & Invest. Web.

Duellmann, K., & M. Erdelmeier (2009): "Crash testing German banks." *International Journal of Central Banking*, *5*(3), 139-175.

Elliot, L. (2011): "Global Financial Crisis: Five Key Stages 2007-2011." *The Guardian*. Guardian News and Media.

Epstein, G., J. Heintz, L. Ndikumana, & G. Chang (2009): "Employment, Poverty and Economic Development in Madagascar: A Macroeconomic Framework." Employment Sector Working Paper Series.

Feldman, S., D. McClain, & K. Palmer (1976): "Sources of Structural Change in the United States, 1963-78: An Input-Output Perspective." The Review of Economics and Statistics 69(3): pp. 503–510.

Fontana, M. (1999): "Improving the environmental performance of vehicles: fleet renewal and scrappage schemes, A report submitted to the Council of Ministers in Warsaw." In *European Conference of Ministers of Transport*.

Gayer, T., & E. Parker (2013): "Cash for Clunkers: An evaluation of the car allowance

rebate system.“ *Brookings Institution*, 9.

Gosh, A. (1958): “Input-Output Approach in an Allocation System.” Economica 25(97): pp. 58–64.

Guo, J. & M. A. Planting (2000): “Using Input-Output Analysis to Mea- sure U.S. Economic Structural Change Over a 24 Year Period.” Bureau of Economic Analysis Working Paper 1.

Hahn, R. W. (1995): “An economic analysis of scrappage.“ *The RAND Journal of Economics*, 222-242.

Hastings, J. and E. Washington (2010): “The First of the Month Effect: Consumer Behavior and Store Responses,” *American Economic Journal: Economic Policy*, *2* (2), 142–162.

House, C. L., & M. D. Shapiro (2006): “Phased-in tax cuts and economic activity.“ *The American Economic Review*, *96*(5), 1835-1849.

Houthakker, H. (1987): “Engel’s law.“ *The New Palgrave Dictionary of Economics*, *2*, 143-144.

Kaul, A., G. Pfeifer, & S. Witte (2012): "The Incidence of Cash for Clunkers: An Analysis of the 2009 Car Scrappage Scheme in Germany." *Working Paper Series* 68: n. pag. University of Zurich. Web.

Kavalec, C., & W. Setiawan (1997): “An analysis of accelerated vehicle retirement programs using a discrete choice personal vehicle model.“ *Transport Policy*, *4*(2), 95-107.

Keogh, G. & P. Quill (2009): “The Construction and Analysis of a Con- sistent Set of Input-Output Tables for the Irish Economy.” Journal of the Royal Statistical Society 172(4): pp. 771–778.

Knittel, C. R. (2009): “The Implied Cost of Carbon Dioxide Under the Cash for Clunkers Program,” Working Paper, Sloan School of Management, Massachusetts Institute of Technology.

Koski, A., R. Sirén, E. Vuori, & K. Poikolainen, K. (2007): “Alcohol tax cuts and increase in alcohol - positive sudden deaths—a time - series intervention analysis. “ *Addiction*, *102*(3), 362-368.

Kulatunga, U., D. Amaratunga, R. Haigh, & R. Rameezdeen (2006): “Attitudes and perceptions of construction workforce on construction waste in sri lanka.” Management of Environmental Quality: An International Journal 17(1): pp. 57–72.

Kuroiwa, I. & H. Kuwamori (2010): “Stock Transmission Mechanism of the Economic Crisis in East Asia: An Application of International Input-Output Analysis.” DE Discussion

Paper 220.

Kweka, J. P., & O. Morrissey (2000): "Government spending and economic growth in Tanzania, 1965-1996." Centre for Research in Economic Development and International Trade, University of Nottingham.

Lapeyre, F. (2010): "Sectoral Engines of Job-Rich Growth: Some Lessons from ILO Sectoral Country Studies." Employment Sector Working Paper Series.

Lavee, D., & N. Becker (2009): "Cost-benefit analysis of an accelerated vehicle-retirement programme." *Journal of Environmental Planning and Management*, *52*(6), 777-795.

Leontief, W. (1936): "Quantitative Input and Output Relations in the Economic System of the United States." The Review of Economic Statistics 18(3): pp. 105–125.

Li, S., J. Linn, and E. Spiller (2012): "Evaluating 'Cash-for-Clunkers': Program Effect on Auto Sales, Jobs, and the Environment," Working Paper, Charles H. Dyson Scool of Applied Economics and Management, Cornell University.

Licandro, O. and A. R. Sampayo (2006): "The Effects of Replacement Schemes on Car Sales: The Spanish Case," *Investigaciones Economicas*, *30* (2), 239–282.

Líšková, L., Bc. (2015): "The Strengths and Limitations of Input-Output Analysis in Evaluating Fiscal Policy." Thesis. Charles University in Prague, 2014/2015. Prague: Charles University in Prague. Print.

Mankiw, N. G. (2014): "Principles of macroeconomics." Cengage Learning.

McLennan, W. (1995): "Information Paper: Australian National Accounts: Introduction to Input-Output Multipliers." Australian Bureau of Statistics Catalogue No.5246.0.

Mian, A., & A. Sufi (2010): "The Effects of Fiscal Stimulus: Evidence from the 2009 'Cash for Clunkers' Program" (No. w16351). National Bureau of Economic Research.

Minford, P. (2002): "The costs and benefits of Economic and Monetary Union to the UK economy-the 'fifth (overview) test'. " *Cardiff Business School*.

Mäkelä, P., & E. Österberg (2009): "Weakening of one more alcohol control pillar: a review of the effects of the alcohol tax cuts in Finland in 2004." *Addiction*, *104*(4), 554-563.

OECD (2015): "Input-Output Tables." *Input-Output Tables*. Web.

OECD (2014): "Growth Prospects And Fiscal Requirements Over The Long Term." *OECD Economic Outlook*, 1.

OECD (2011): "International Transport Forum." *Car Fleet Renewal Schemes: Environmental and Safety ImpactsCar Fleet Renewal*: n. pag. Web.

Park, J. Y. (2006): "The Supply-Driven Input-Output Model: A Reinterpre- tation and Extension." Non-published Research Reports (Paper 124).

Park, S.-H. & K. S. Chan (1989): "A Cross-Country Input-Output Analysis of Intersectoral Relationships between Manufacturing and Services and Their Employment Implications." World Development 17: pp. 199–212.

Pietroforte, R. & T. Gregori (2003): "An Input-Output Analysis of the Construction Sector in Highly Developed Economies." Construction Management and Economics 21(3): pp. 319–327.

Reis, H. & A. Rua (2009): "An Input-Output Analysis: Linkages vs Leak- ages." International Economic Journal 23(4): pp. 527–544.

Sasai, Y., T. Hasegawa, T. Imagawa, & M. Ono (2012): "The Prediction of CO2 Emissions up to 2020 in Japanese Economic Activities." The Journal of Econometric Study of Northeast Asia 8: pp. 75–97.

Schumpeter, J. (1942): "Capitalism, Socialism and Democracy." Routledge.

Suga, M. (2012): "Input-Output Analysis of Dispatched Employees in Japan."

Szwarcfiter, L., F. E. Mendes, & E. L. La Rovere (2005): "Enhancing the effects of the Brazilian program to reduce atmospheric pollutant emissions from vehicles." *Transportation Research Part D: Transport and Environment*, *10*(2), 153-160.

Tanaka, F. J. (2011): "Applications of Leontief's Input-Output Analysis in Our Economy."

Timmer, M., A. A. Erumban, R. Gouma, B. Los, U. Temurshoev, G. J. de Vries, … & O. Pindyuk (2012): "The world input-output database (WIOD): contents, sources and methods" (No. 20120401). Institue for International and Development Economics.

Toder, E. J. (2000): "Tax Cuts or Spending—Does It Make a Difference?." *National Tax Journal*, 361-371.

Tretyakova, A. & I. Birman (1976): "Input-Output Analysis in the USSR." Soviet Studies 28(2): pp. 157–186.

Tsoukalas, J. (2011): "Input and Output Inventories in the UK." Journal of the Royal Statistical Society 78(3): pp. 460–479.

Uhlig, H. (2002): "One Money, but Many Fiscal Policies in Europe: What are the consequences?"

West, G. R. (1995): "Comparison of Input–Output, Input–Output + Econo- metric and Computable General Equilibrium Impact Models at the Regional Level." Economic Systems Research 7(2): pp. 209–227.

Zamecnik, M. & J. Hlavac (2010): "Duvody pro zateplovani domu: desetitisice pracovnich mist v Cesku."